Preinstallation Manual
Paladin™ Advanced Mode Locked UV Laser System

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Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside normal office hours will be documented by our automatic answering system and will be promptly returned the next business day.

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Preface

This manual contains user information for the Paladin™ Advanced Mode Locked UV laser system.

Read this manual carefully before operating the laser for the first time. Special attention must be given to the material in "Section One: Safety" on page 1, that describes the safety features built into the laser.

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification must be obtained from Coherent or an appropriate U.S. Government agency.

These commodities, technology, or software are subject to European Union export regulations and local laws. Diversion contrary to European Union law prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited.

FRENCH TRANSLATION/ TRADUCTION FRANÇAISE

Préface

Ce manuel contient l'information utilisateur pour le système laser Paladin™ Advanced Mode Locked UV.

Veuillez lire attentivement ce manuel avant d'actionner le laser pour la première fois. Une attention particulière doit être portée au matériel dans la " Section 1 : Sécurité du laser " à la page 1, qui décrit les dispositifs de sécurité intégrés au laser.

L'utilisation de commandes ou de réglages ou l'exécution de procédures autres que ceux spécifiés dans la présente peut avoir comme conséquence l'exposition à un rayonnement dangereux.

Avertissements et symboles de sécurité utilisés dans ce manuel

Cette documentation peut contenir des sections dans lesquelles des risques particuliers sont identifiés ou lorsqu'une attention particulière est requise dans des conditions spécifiques. Ces sections sont indiquées par des avertissements de sécurité selon la norme ANSI Z-535.6 et des symboles de sécurité (pictogrammes d'alertes de risque) selon les normes ANSI Z-535.3 et ISO 7010.

Avertissements de sécurité

Quatre avertissements de sécurité sont utilisés dans cette documentation : DANGER, AVERTISSEMENT, ATTENTION et AVIS.

Les avertissements de sécurité DANGER, AVERTISSEMENT et ATTENTION désignent le degré ou le niveau de risque lorsqu'il existe un risque de blessure :

DANGER !
Désigne une situation de risque qui, si elle n'est pas évitée, aura pour conséquence la mort ou des blessures graves. L'avertissement de sécurité doit être limité aux situations les plus extrêmes.

AVERTISSEMENT !
Désigne une situation de risque qui, si elle n'est pas évitée, pourrait avoir pour conséquence la mort ou des blessures graves.

ATTENTION!
Désigne une situation de risque qui, si elle n'est pas évitée, pourrait avoir pour conséquence une blessure mineure ou modérée.

L'avertissement "***AVIS!***" est utilisé lorsqu'il existe un risque d'endommager le bien:

AVIS!
Indique une information considérée comme importante, mais sans lien avec un risque potentiel.

Les messages relatifs à des risques pouvant avoir pour conséquence à la fois des blessures aux personnes ou des dommages matériels sont considérés comme des messages de sécurité et non comme des messages de dommages matériels.

Symboles

Les avertissements de sécurité DANGER, AVERTISSEMENT et ATTENTION sont systématiquement accentués par un symbole de sécurité qui indique un risque particulier, indépendamment du niveau de risque:

Ce symbole est prévu pour alerter l'opérateur de la présence d'instructions importantes d'utilisation et d'entretien.

Ce symbole est prévu pour alerter l'opérateur du danger de l'exposition au rayonnement laser visible et invisible dangereux.

Ce symbole est prévu pour alerter l'opérateur de la présence de tensions dangereuses dans le carter du produit qui peuvent être suffisamment importantes pour constituer un risque de décharge électrique.

Ce symbole est prévu pour alerter l'opérateur du danger de susceptibilité aux décharges électrostatiques (ESD).

Ce symbole est prévu pour alerter l'opérateur du danger de blessure par écrasement.

Ce symbole est prévu pour alerter l'opérateur du danger lié à un risque de levage.

Conformité avec les lois de contrôle des exportations

Coherent a pour politique de se conformer strictement aux lois de contrôle des exportations des États-Unis.

L'exportation et la réexportation des lasers construits par Coherent sont sujettes aux règlements d'administration des exportations des États-Unis, gérés par le département américain du commerce. En outre, les expéditions de certains composants sont réglementées par le département d'État en vertu de la réglementation visant le trafic international d'armes.

Les restrictions applicables varient selon le produit spécifique impliqué et sa destination. Dans certains cas, la loi des États-Unis exige que l'accord du gouvernement des États-Unis soit obtenu avant la revente, l'exportation ou la réexportation de certains articles. Quand il y a incertitude sur les obligations imposées par la loi des États-Unis, une clarification doit être obtenue auprès de Coherent ou d'un organisme gouvernemental compétent des États-Unis.

Ces produits, technologies et logiciels sont soumis aux règles d'exportation de la Communauté Europeénne et aux lois locales. Des versions contraires aux lois Européennes sont interdites.

L'utilisation, la vente, la ré-exportation ou un transfert directement ou indirectement pour toutes activités interdites sont strictement interdites.

SECTION ONE: SAFETY

Introduction

The Paladin Advanced Laser system has been designed to provide protection to the operator in the event of any single component failure, provided that the system is installed and operated properly as described in the Operator's manual. All laser users must read, understand, and follow the safety warnings and operating instructions contained within the operator's manual.

Because the manufacturer is unable to guarantee the safety of laser users in the event of two independent component failures, this equipment must not be operated if there is evidence of any personnel hazard, component failure, improper installation, or significant damage. The failure of a single component is not hazardous, but may allow for no protection against, or warning of, a hazardous condition if another failure occurs. Routinely inspect the laser system for evidence of potential safety hazards or component failures.

If it is suspected that the laser system is missing safety related parts, has been damaged, or may otherwise be unsafe, turn the laser off, disconnect the input power immediately, and contact your local Coherent service representative. Do not operate the laser until all potential safety hazards have been eliminated. Do not remove any housings or protective covers unless directed to do so by a certified Coherent service representative.

Optical Safety

Laser light, because of its special properties, poses safety hazards not associated with light from conventional sources. The safe use of lasers requires that all laser users, and everyone near the laser system, are aware of the dangers involved. The safe use of the laser depends upon the user being familiar with the instrument and the properties of coherent, intense beams of light.

DANGER!
Direct eye contact with the output beam from the laser will cause serious damage and possible blindness.

Laser beams can ignite volatile substances such as alcohol, gasoline, ether and other solvents, and can damage light-sensitive elements in video cameras, photomultipliers and photodiodes. Reflected beams may also cause damage. For these reasons, and others, the user is advised to follow the precautions below.

1. Observe all safety precautions in the operator's manual.
2. Extreme caution must be exercised when using solvents in the area of the laser.
3. Limit access to the laser to qualified users who are familiar with laser safety practices and who are aware of the dangers involved.
4. Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam into the source.
5. Maintain experimental setups at low heights to prevent inadvertent beam-eye encounter during operation.

DANGER!
Laser safety glasses can present a hazard as well as a benefit; while they protect the eye from potentially damaging exposure, they block light at the laser wavelengths preventing the operator from seeing the beam. Therefore, use extreme caution even when using safety glasses.

6. As a precaution against accidental exposure to the output beam or its reflection, those using the system must wear laser safety glasses as required by the wavelength being generated.
7. Avoid direct exposure to the laser light. The intensity of the beam can easily burn personnel and ignite clothing.
8. Use the laser in an enclosed room. Laser light will remain collimated over long distances and therefore presents a potential hazard if not confined.
9. Post warning signs in the area of the laser beam to alert those present.
10. Advise all those using the laser of these precautions. It is good practice to operate the laser in a room with controlled and restricted access.

Electrical Safety

The Paladin Advanced Mode Locked UV laser system contains potentially hazardous voltages inside the protective enclosures of the power supply and laser head. Do not open the protective enclosures. Do not operate the laser system without a protective earth (safety) ground connected to the facility power inlet connector.

Safety Features and Compliance to Government Regulations

The following features are incorporated into the Paladin Advanced laser system to conform to several government requirements. The applicable United States Government requirements are contained in 21 CFR, subchapter J, part II administered by the Center for Devices and Radiological Health (CDRH). The European Community requirements for product safety are specified in the Low Voltage Directive (LVD) (published in 2006/95/EC). The Low Voltage Directive requires that lasers comply with the standards UL 61010-1:2012 and CAN/CSA-C22.2 No. 61010-1-12 "Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use" and EN60825-1 "Radiation Safety of Laser Products". Compliance of this laser with the (LVD) requirements is certified by the CE mark.

Shutter Operation

The EMBS (Electro-Magnetic Beam Shutter) is fail-safe related to Category 3 and PL d acc. to EN ISO 13849-1. It is normally closed and closes in direction of gravity. The shutter status is monitored continuously via two light barriers, one for the OFF status and one for ON status.

The shutter will close in standard operation within 10 ms. The reaction time of the shutter at an alarm is 25 ms.

If a shutter problem occurs, the laser diodes are disabled.

NOTICE!
The shutter is a required safety feature for laser operation. It is not to be used as a means to control exposure time!

External Interlock

The system will not operate with the interlock open. An INTERLOCK connector is located on the master power supply rear panel (see Figure 4-2). The interlock status is monitored by the CPU of the control board located in the master power supply. If the interlock is opened, a message will be displayed on the power supply front panel.

To properly integrate the laser in the safety control of the application, an external interlock circuit must be connected to the laser system and wired to a door switch or access panel to provide additional operating safety. When a door is opened, the laser will shut down and the shutter will close. The fault must be cleared and the diodes turned on to restart the laser.

To incorporate an external safety interlock circuit into the laser system, turn off the laser and remove the jumper from the interlock connector on the master power supply rear panel. Attach a user furnished external interlock circuit to this connector. Any external interlock circuit must be equivalent to a mechanical closure of the circuit. Under no circumstances should an external voltage or current source be connected to this circuit. External interlock circuitry must be isolated from all other electrical circuit or grounds.

For the INTERLOCK a short (less than 1K ohms) between pins allows normal operation while an open (greater than 10K ohms) prevents laser emission.

Shutter Interlock

The shutter will not open unless the shutter interlock circuit is closed. If the shutter interlock (EMBS) circuit is opened while the laser is operating, it will cause the shutter to close but will not turn the laser off.

For the EMBS, a short between the top two pins allows the shutter to operate normally while an open prevents the shutter from being opened. Impedance of the short must be less than 100 Ohms. Impedance of the open must be greater than 5K Ohms, galvanic isolation preferred. Current through a short will typically be 20mA.

Laser Classification

The governmental standards and requirements specify that the laser must be classified according to the output power or energy and the laser wavelength. The Paladin Advanced is classified as Class IV based on 21 CFR, subchapter J, part II, section 1040-10 (d). According to the European Community standards, the Paladin Advanced laser is classified as Class 4 based on EN 60825-1, clause 9. In this manual, the classification will be referred to as Class 4.

Protective Housing

The laser head is enclosed in a protective housing that prevents human access to radiation in excess of the limits of Class I radiation.

Laser Emission Indicators

The appropriately labeled lights on both the power supply and the laser head illuminate when the laser on button is set to the LASER ON position before laser emission can occur. White or yellow lights are used and are visible while wearing safety glasses.

Operating Controls

The laser controls are positioned so that the operator is not exposed to laser emission while manipulating the controls.

DANGER!
Use of the system controls in a manner other than that described herein may impair the protection provided by the system, resulting in hazardous levels of laser radiation exposure to the operator.

Electromagnetic Compatibility

The Paladin Advanced laser system complies with the European requirements for electromagnetic compatibility as defined in the Electromagnetic Compatibility Directive 2004/108/EC.

The Paladin Advanced laser system is intended for use in an Industrial Environment. Operation of this laser system in a different EMC environment (Residential, for example) may require that the user take remedial action in addition to the normal installation, operation, and maintenance described in this manual to resolve potential electromagnetic compatibility problems. Coherent makes no claims beyond those listed below concerning the compatibility of this laser system in EMC environments other than the Industrial environment.

Coherent Inc. declares that the Paladin Advanced laser system meets the requirements of the EMC Directive 2004/108/EC based on the following standards:

- EN 50081-1, Emission, March 1993
- EN 55022, Kl. B
- EN 61000-3-2, -3
- EN 61000-6-2, Susceptibility, March 1999
- EN 61000-4-2,-2, -4, -5, -6, -11
- EN 50204

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label (Figure 1-1). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

Battery Directive

The batteries used in this product are in compliance with the EU Directive 2006/66/EC ("EU Battery Directive").

Table 1-1. Batteries Contained in this Product

DESCRIPTION	TYPE
12V rechargeable	Pb-ACID

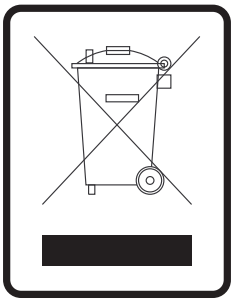


Figure 1-1. EU Battery Directive Label

Dispose of batteries according to local regulations. Do not dispose as normal waste. Consult your local waste authorities for guidance.

Maximum Noise Level dB(A)

The noise level of the Paladin Laser System is under 80 dB(A). No sonic hazard is present.

Location of Labels

Refer to the following figures and tables in this chapter for locations and descriptions of all labels. These include warning labels indicating removable or replaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification [CFR 1040.10(g), CFR 1040.2, and CFR 1010.3/ EN 60825-1, Clause 5]].

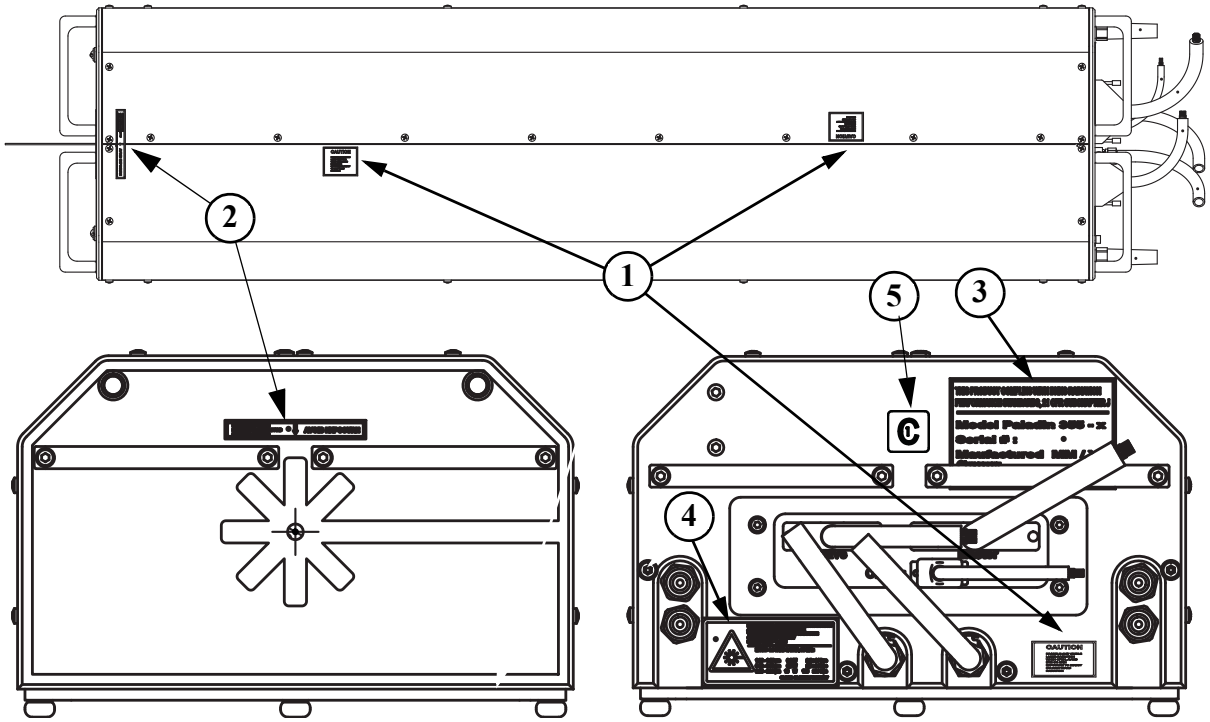


Figure 1-2. Label Locations on the Laser Head

Table 1-2. Label Descriptions - Head

ITEM	LABEL	DESCRIPTION
1.		Caution Label: Cautions the user of possible exposure to laser radiation if the cover is removed. The Paladin is a class IV laser system. It emits both invisible and visible laser radiation that potentially can cause skin or eye damage. This this label is located on the top cover of the laser head and power supply.
2.		Avoid Exposure Label: The Paladin is a class IV laser system. It emits both invisible and visible laser radiation that potentially can cause skin or eye damage. Laser radiation warnings are thus located at the laser head where eye or skin exposure to the laser beam is most likely to occur. This includes the laser aperture and front bezel.
3.		Product Label: This label states the compliance to DHHS Performance Radiation Standards 21 CFR Ch. I, EN 60825-1 for this product. It also contains the model, serial number, manufacturing date, part number and product origin. Contains the European Waste Electrical and Electronic Equipment (WEEE) Directive Label (lower right corner): See “Waste Electrical and Electronic Equipment (WEEE, 2002)” on page 1-6.

Table 1-2. Label Descriptions - Head (Continued)

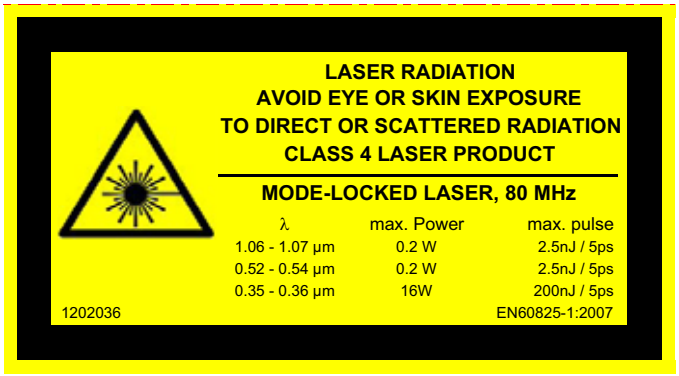
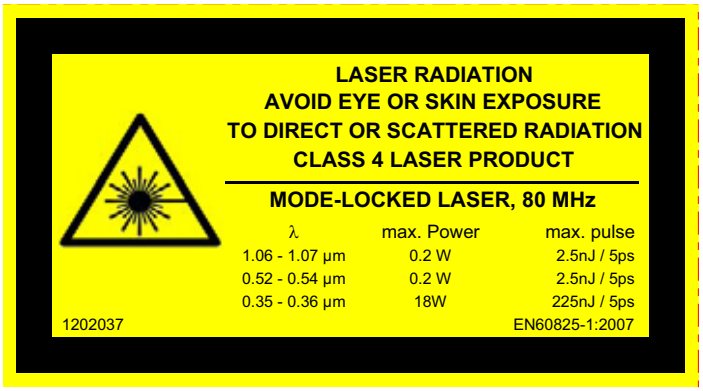
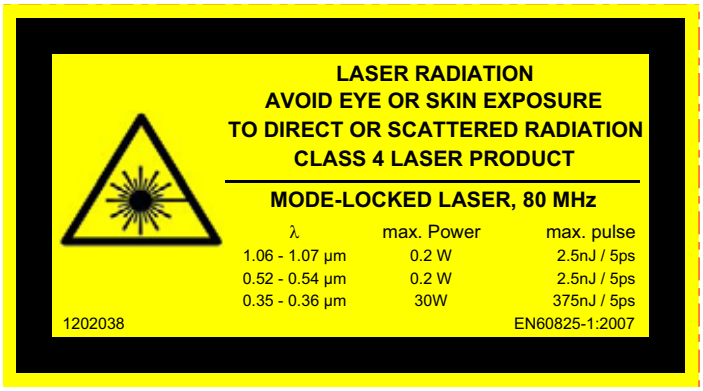
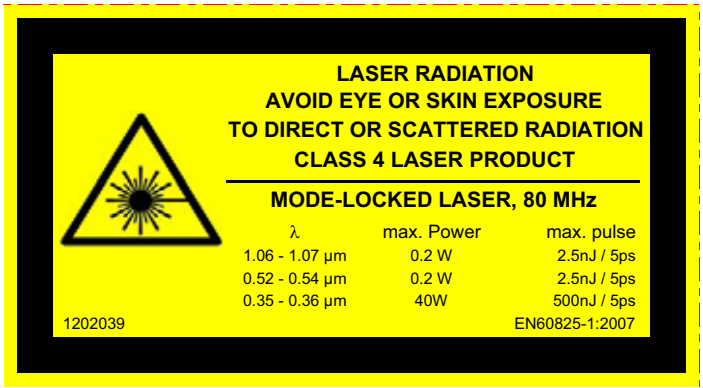
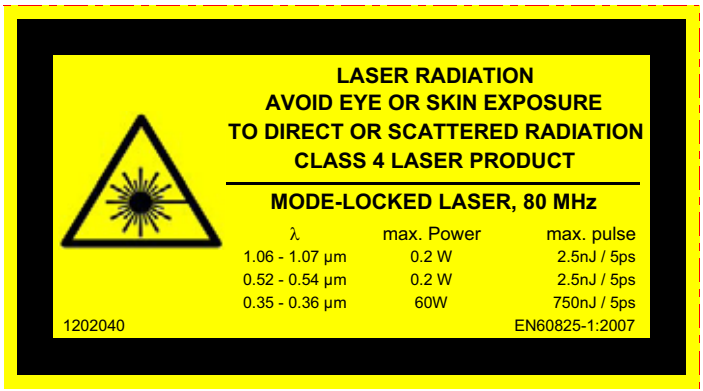
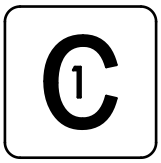
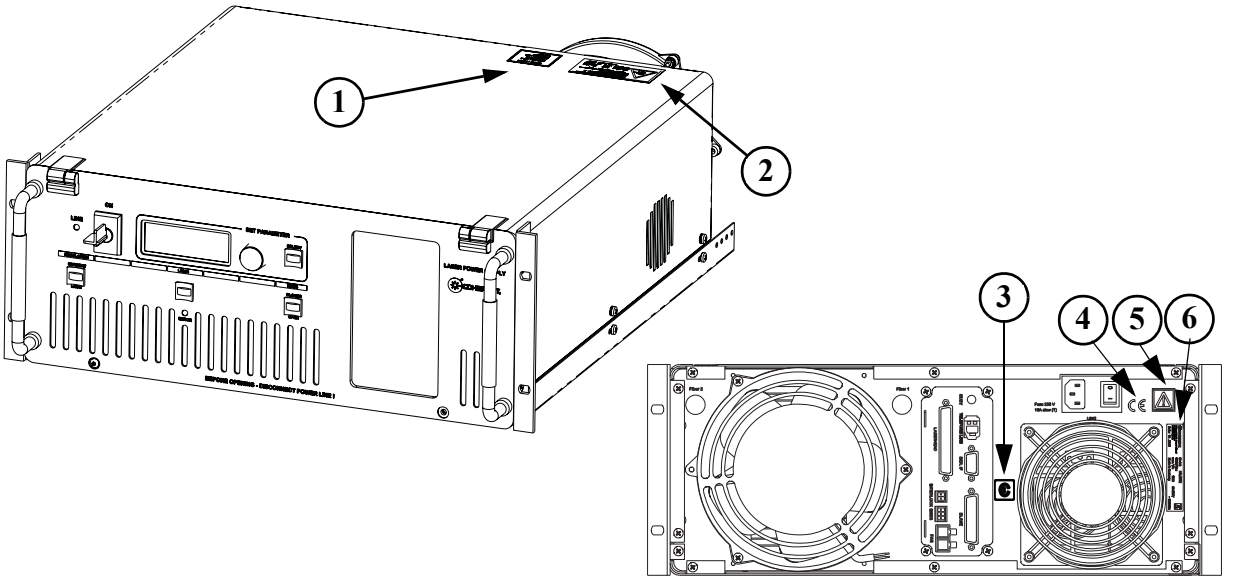
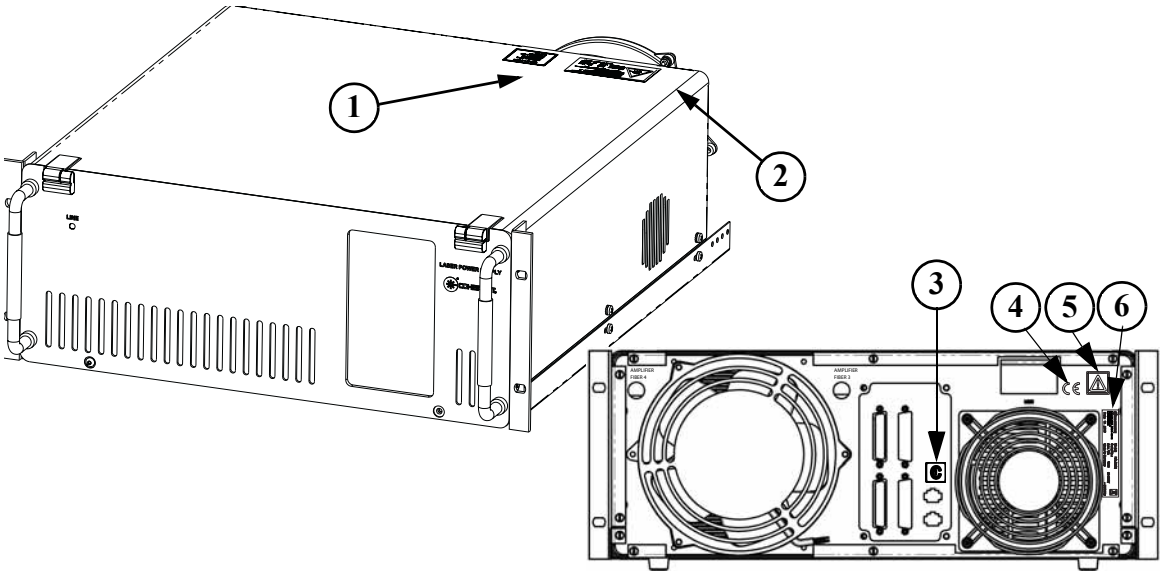
ITEM	LABEL	DESCRIPTION
4.	 Paladin ADVANCED 355-8000  Paladin ADVANCED 355-10000  Paladin ADVANCED 355-16000	Laser Product Label: This label describes the specific wavelength and output power level capabilities of the Laser Head. It also includes the laser class of the product. For more information, refer to “Laser Classification” on page 1-4 Laser Product Label: This label describes the specific wavelength and output power level capabilities of the Laser Head. It also includes the laser class of the product. For more information, refer to “Laser Classification” on page 1-4

Table 1-2. Label Descriptions - Head (Continued)

ITEM	LABEL	DESCRIPTION
	 Paladin ADVANCED 355-24000	
	 Paladin ADVANCED 355-35000	
5.		Canada-C1 Label: This label certifies that the product has been tested to the requirements of CAN/CSA-C22.2 No. 61010-1-12, second edition, including Amendment 1, or a later version of the same standard incorporating the same level of testing requirements.



MASTER



SLAVE

Figure 1-3. Label Locations - Power Supply

Table 1-3. Label Descriptions - Power Supply

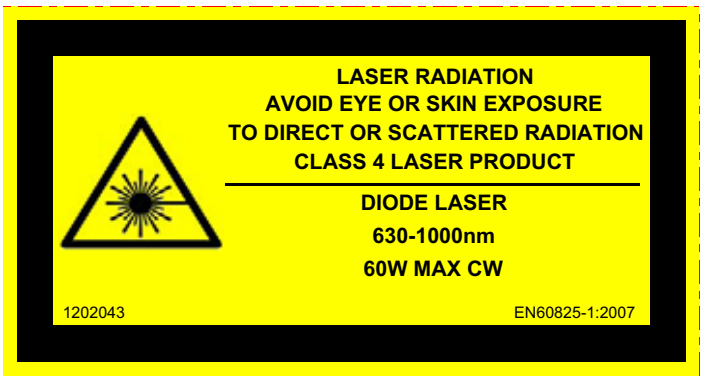
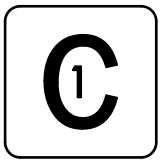
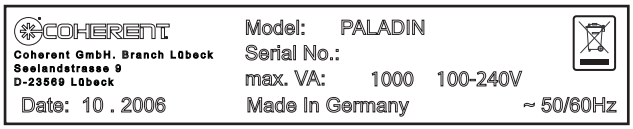
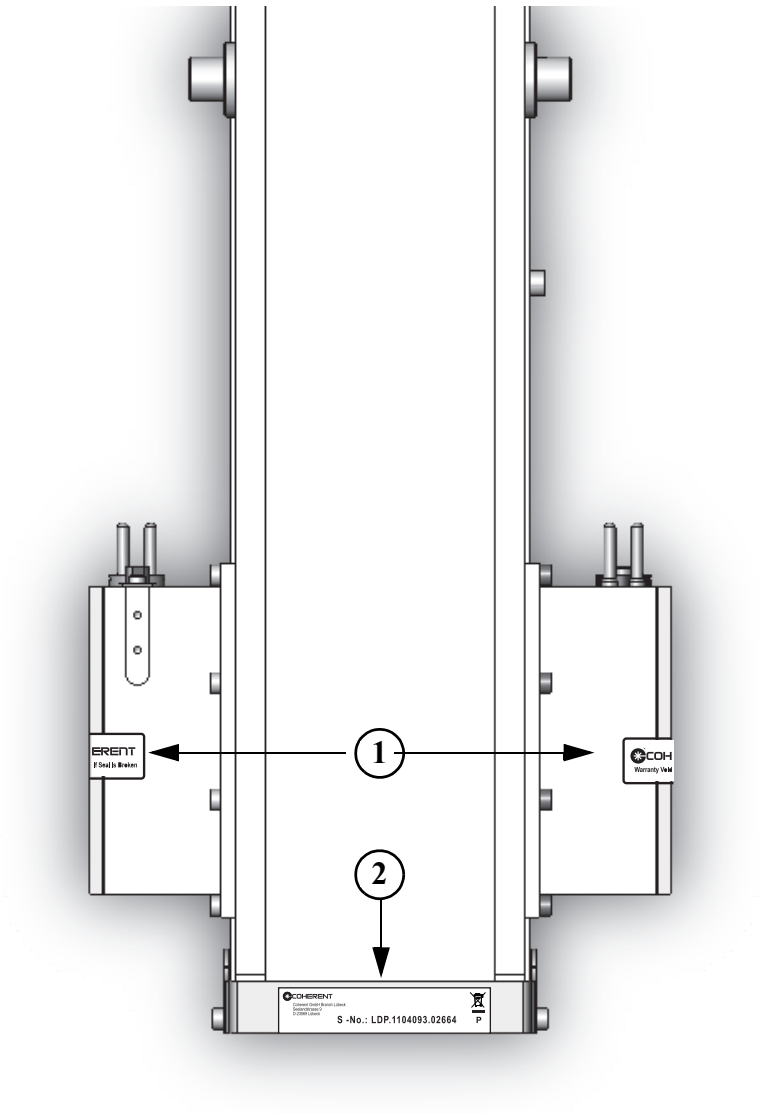
ITEM	LABEL	DESCRIPTION
1.		Caution Label: Cautions the user of possible exposure to laser radiation if the cover is removed.
2.		Laser Diode Product Label: This label describes the specific wavelength and output power level capabilities of the laser diodes. It also includes the laser class of the product. For more information, refer to "Safety Features and Compliance to Government Regulations" on page 1-3
3.		This product has been tested to the requirements of the CAN/CSA-C22.2 No. 610-10-1, second edition, including Amendment 1, or later version of the same standard incorporating the same level of testing requirements.
4.		CE Certification Label: Complies with the low voltage directive. Refer to "Safety Features and Compliance to Government Regulations" on page 1-3.

Table 1-3. Label Descriptions - Power Supply (Continued)

ITEM	LABEL	DESCRIPTION
5.		Identifies the presence of important operating and maintenance instructions. Use caution when working near this area of the system.
6.		Identification Label for the Power Supply: Contains the manufacturing date, model number, serial number and product origin. Also contains the WEEE symbol that is described in "Waste Electrical and Electronic Equipment (WEEE, 2002)" on page 1-6



Pump Module Top-Down View (inside power supply)

Figure 1-4. Label Locations - Pump Module

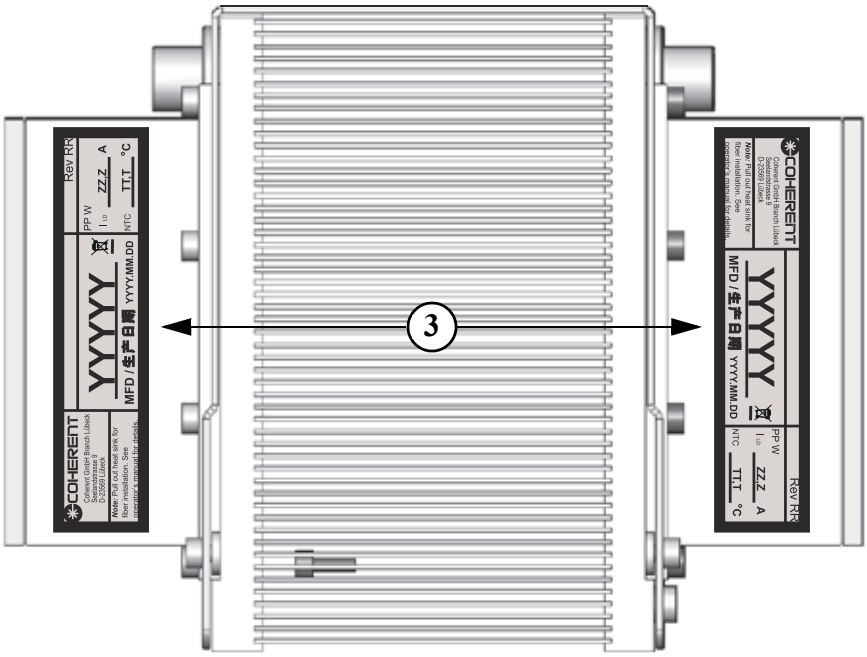


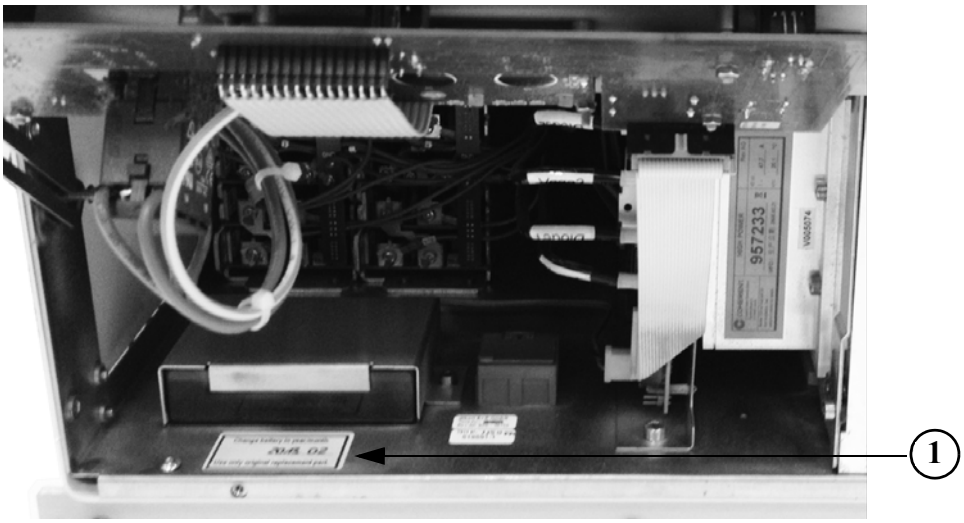
Figure 1-4. Label Locations - Pump Module (Continued)

Table 1-4. Label Definitions - Pump Module

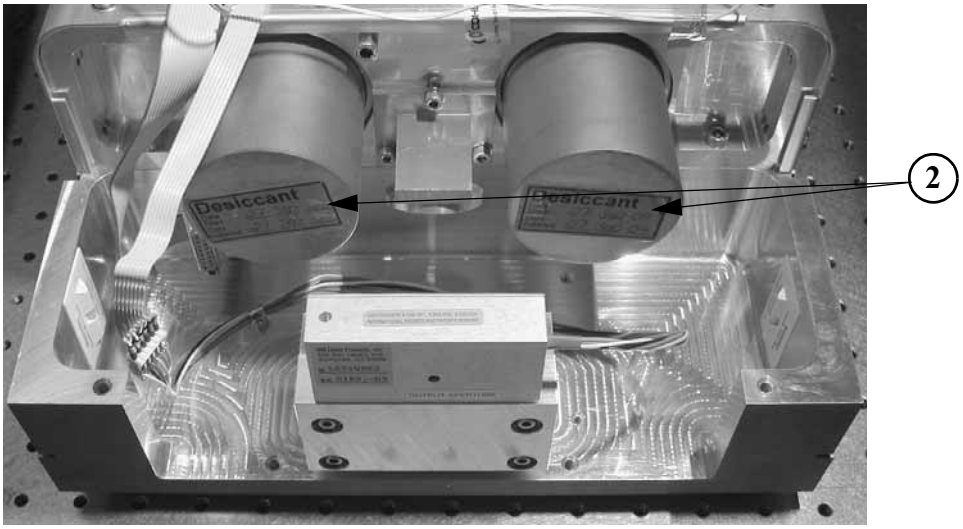
ITEM	LABEL	DESCRIPTION
1.	COHERENT Warranty Void If Seal Is Broken	Warranty Label: Warns that the warranty of the product will be void if the seal is broken. This is commonly used to prevent unauthorized access to internal components. Refer to "Warranty" on page B-1

Table 1-4. Label Definitions - Pump Module (Continued)

ITEM	LABEL	DESCRIPTION
2.		Pump Module Serial Number Label: Contains the serial number and product origin. Also contains the WEEE symbol that is described in "Waste Electrical and Electronic Equipment (WEEE, 2002)" on page 1-6.
3.		Identification Label for the Pump Module: Contains the manufacturing date, model number, serial number and product origin. Also contains the WEEE symbol that is described in "Waste Electrical and Electronic Equipment (WEEE, 2002)" on page 1-6.



Inside Power Supply



Inside Laser Head (front bezel removed)

ITEM	LABEL	DESCRIPTION
1.	Change battery in year/month. ...../..... Use only original replacement parts.	Battery Label: The power supply contains a battery to control the ramp down and cooling of the laser head. This label is located in the power supply next to the battery pack and gives the recommended change date of the battery.
2.	Desiccant Date filled: _____ Date installed:_____	Desiccant Label: Shows the fill and install date of the desiccant container. The labels have a yellow background color, the outline and print are in black. It is located on the bottom of the desiccant container.

Figure 1-5. Label Locations Internal

FRENCH TRANSLATION/ TRADUCTION FRANÇAISE SECTION 1: SÉCURETÉ

Introduction

Le système Paladin™ Advanced Laser a été conçu pour assurer la protection de l'opérateur en cas de défaillance de n'importe quel composant, à condition que le système soit installé et actionné correctement selon les descriptions du manuel de l'opérateur. Tous les utilisateurs du laser doivent lire, comprendre et respecter les avertissements de sécurité et les consignes d'utilisation contenus dans le manuel de l'opérateur.

Le fabricant ne pouvant garantir la sécurité des utilisateurs du laser en cas de défaillances de deux composants indépendants, cet équipement ne doit pas être actionné s'il y a évidence du moindre risque pour le personnel, défaillance de composant, installation incorrecte ou dommages significatifs. La défaillance d'un composant unique ne présente pas de danger, mais peut conduire à l'absence de protection, ou d'avertissement, d'un état dangereux si une autre défaillance se produit. Inspectez régulièrement le système laser pour prévenir la survenance de risques potentiels en matière de sécurité ou de défaillances de composants.

Si on suspecte que des pièces liées à la sécurité sont manquantes, que le système laser a été endommagé, ou peut être autrement considéré comme peu sûr, arrêtez le laser, débranchez sans délai l'alimentation électrique, et contactez votre technicien Coherent local. N'actionnez pas le laser jusqu'à ce tous les risques potentiels en matière de sécurité aient été éliminés. Ne retirez aucun carter ou couvercle de protection à moins qu'un technicien Coherent agréé vous ait demandé de le faire.

Sécurité optique

La lumière laser, en raison de ses propriétés particulières, présente des risques en matière de sécurité incomparables à la lumière des sources conventionnelles. Une utilisation sûre des lasers exige que tous les utilisateurs de laser, ainsi que toutes les personnes situées à proximité du système laser, soient avertis des dangers impliqués. La sécurité de l'utilisation est liée au degré de familiarisation de l'utilisateur avec l'instrument et avec les propriétés des intenses rayons de lumière cohérente.

DANGER !
Le contact direct de l'œil avec la sortie du rayon laser provoquera des dommages sérieux et peut entraîner la cécité.

Les rayons laser peuvent mettre à feu certaines substances volatiles telles que l'alcool, l'essence, l'éther et d'autres dissolvants, et peuvent endommager les éléments sensibles à la lumière des caméras vidéo, des photomultiplicateurs et des photodiodes. Les rayons réfléchis peuvent également provoquer des dommages. Pour ces raisons et d'autres, il est fortement conseillé à l'utilisateur de respecter les précautions ci-dessous.

1. Observez toutes les mesures de sécurité du manuel de l'opérateur.
2. Une attention extrême doit être portée lors de l'utilisation de solvants dans les environs du laser.
3. Limitez l'accès au laser aux utilisateurs qualifiés familiarisés avec les pratiques en matière de sécurité des lasers et informés des dangers impliqués.
4. Ne regardez jamais directement vers la source lumineuse du laser ou vers la lumière laser dispersée par n'importe quelle surface réfléchissante. Ne regardez jamais le faisceau directement à sa source.
5. Maintenez les installations expérimentales à de faibles hauteurs pour empêcher toute rencontre fortuite du rayon avec l'œil lors du fonctionnement.

DANGER !
Les lunettes de protection Laser peuvent présenter un risque aussi bien qu'un bénéfice ; en effet, elles protègent l'œil contre les expositions potentiellement préjudiciables, mais elles bloquent la lumière aux longueurs d'onde du laser empêchant ainsi l'opérateur d'apercevoir le rayon. En conséquence, soyez très vigilant lors de l'utilisation de lunettes de sécurité.

6. Comme précaution contre l'exposition accidentelle au rayon de sortie ou à sa réflexion, les utilisateurs du système doivent porter des lunettes de sécurité laser conformes aux caractéristiques de la longueur d'onde produite.

7. Évitez l'exposition directe à la lumière laser. L'intensité du rayon peut facilement brûler les personnes et mettre à feu l'habillement.
8. Utilisez le laser dans une salle fermée. La lumière laser reste collimatée sur de longues distances et présente donc un risque si elle n'est pas confinée.
9. Affichez les panneaux d'avertissement dans les environs du rayon laser pour alerter les personnes présentes.
10. Informez tous ceux qui utilisent le laser de ces précautions. Il est recommandé d'actionner le laser dans une salle à accès contrôlé et restreint.

Sécurité électrique

Le système laser Paladin™ Advanced Mode Locked UV enferme des tensions potentiellement dangereuses à l'intérieur des carters de protection du bloc d'alimentation électrique et de la tête du laser. N'ouvrez pas les carters de protection. N'actionnez pas le système laser sans mise à la terre (sécurité) reliée au connecteur d'entrée de l'alimentation de l'installation.

Dispositifs de sécurité et conformité avec les réglementations gouvernementales

Les dispositifs suivants sont incorporés au système laser Paladin™ Advanced afin de répondre à plusieurs exigences gouvernementales. Les exigences applicables du gouvernement des États-Unis sont contenues dans le CFR 21, sous-chapitre J, partie II administrée par le Centre pour les appareils radiologiques du ministère de la Santé (Center for Devices and Radiological Health, CDRH). Les exigences de la Communauté européenne pour la sécurité des produits sont définies dans la Directive basse tension (Low Voltage Directive, LVD) (publiée dans la norme 2006/95/EC). La Directive basse tension exige que les lasers soient conformes aux normes UL 61010-1:2012 and CAN/CSA-C22.2 No. 61010-1-12 " Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire " et EN60825-1 " Sécurité des appareils à laser ". La conformité de ce laser avec les conditions (LVD) est certifiée par le marquage CE.

Fonctionnement de l'obturateur

L'EMBS (Electro-Magnetic Beam Shutter, obturateur de rayon électromagnétique) est sécurisé conformément à la catégorie 3 de la norme EN ISO 13849-1. Il est normalement fermé et son ouverture s'effectue dans la direction de la gravité. L'état de l'obturateur est contrôlé en permanence par deux barrières lumineuses, l'une pour l'état désactivé, et l'autre pour l'état activé.

En fonctionnement normal, l'obturateur se ferme en 10 ms. Le délai de réaction de l'obturateur à une alarme est de 50 ms.

Dans le cas d'un problème avec l'obturateur les diodes laser seront désactivées.

AVIS!
L'obturateur est un dispositif de sécurité exigé pour le fonctionnement du laser. Il ne doit pas être utilisé comme moyen de contrôle de la durée de l'exposition !

Verrou externe

Ni le système ni l'obturateur ne fonctionnent quand le connecteur est ouvert. Un connecteur de verrouillage (INTERLOCK) et le connecteur de l'EMBS (Electro-Magnetic Beam Shutter, obturateur de rayon électromagnétique) sont situés sur le panneau arrière du bloc d'alimentation (voir figure 2-2).

Un circuit externe de verrouillage et un circuit d'obturateur de rayon (séparés l'un de l'autre) peuvent être reliés au système laser et être câblés à un commutateur de porte pour fournir une sécurité supplémentaire en utilisation. Quand la porte est ouverte, l'obturateur se ferme (EMBS) et le laser s'arrête (verrouillage).

Pour intégrer un verrouillage externe de sécurité ou un circuit EMBS au système laser, désactivez le laser et retirez le cavalier des connecteurs INTERLOCK et/ou EMBS sur le panneau arrière du bloc d'alimentation. Connectez un circuit de verrouillage externe fourni par l'utilisateur à ce connecteur.

Pour le verrouillage (INTERLOCK), un court-circuit (inférieur à 1 kOhm) entre les broches permet le fonctionnement normal tandis qu'un circuit ouvert (supérieur à 10 kOhms) empêche le laser d'émettre.

Pour l'EMBS, un court-circuit entre les deux broches principales permet à l'obturateur de fonctionner normalement tandis qu'un circuit ouvert empêche l'obturateur d'être ouvert. L'impédance du court-circuit doit être inférieure à 100 Ohms. L'impédance du circuit ouvert doit être supérieure à 5 kOhms, isolement galvanique privilégié. Le courant à travers un court-circuit sera généralement de 20 mA. Le système ne fonctionnera pas avec le verrouillage ouvert. Un connecteur INTERLOCK est situé sur le panneau arrière de l'alimentation électrique principale (voir figure 3-21). Le statut de verrouillage est surveillé par le processeur de la carte située dans le bloc d'alimentation principal. Si le verrouillage est ouvert, un message sera affiché sur le panneau avant du bloc d'alimentation.

Pour intégrer correctement le laser dans la commande de sécurité de l'application, un circuit externe de verrouillage doit être relié au système laser et être câblé à un commutateur de porte ou à un panneau d'accès pour fournir la sécurité opérationnelle additionnelle. Quand une porte est ouverte, le laser s'arrête et l'obturateur se ferme. Le défaut doit être éliminé et les diodes doivent être allumées pour remettre en marche le laser.

Pour incorporer un circuit externe de contact de sécurité au système laser, arrêtez le laser et enlevez le cavalier du connecteur INTERLOCK sur le panneau arrière du bloc d'alimentation principale. Connectez un circuit externe de verrouillage fourni par l'utilisateur à ce connecteur. N'importe quel circuit externe de verrouillage doit être équivalent à une fermeture mécanique du circuit. En aucun cas, une tension externe ou une source de courant ne doit être reliée à ce circuit. Les circuits externes de verrouillage doivent être isolés de tout autre circuit électrique ou de mis à la terre.

Pour le verrouillage (INTERLOCK), un court-circuit (inférieur à 1 kOhm) entre les broches permet le fonctionnement normal tandis qu'un circuit ouvert (supérieur à 10 kOhms) empêche le laser d'émettre.

Verrouillage de l'obturateur

L'obturateur ne s'ouvre pas que si le circuit de verrouillage de l'obturateur est fermé. Si le circuit de verrouillage de l'obturateur (EMBS) est ouvert tandis que le laser fonctionne, il entraînera la fermeture de l'obturateur mais n'arrêtera pas le laser.

Pour l'EMBS, un court-circuit entre les deux broches principales permet à l'obturateur de fonctionner normalement tandis qu'un circuit ouvert empêche l'ouverture de l'obturateur. L'impédance du court-circuit doit être inférieure à 100 Ohms. L'impédance du circuit ouvert doit être supérieure à 5 kOhms, isolement galvanique privilégié. Le courant à travers un court-circuit sera généralement de 20 mA.

Classification du laser

Les normes et exigences gouvernementales précisent que le laser doit être classé selon la puissance ou l'énergie de sortie et la longueur d'onde du laser. Le Paladin™ Advanced est classé en Classe IV sur la base de la certification CFR 21, sous-chapitre J, partie II, section 1040-10 (d). Selon les normes de la Communauté européenne, le laser Paladin™ Advanced est classé en Classe 4 sur la base de la norme EN 60825-1, clause 9. Dans ce manuel, la classification sera référencée Classe 4.

Carter de protection

La tête de laser est enfermée dans un carter de protection qui empêche tout accès humain au rayonnement au-dessus des limites du rayonnement de la classe I.

Indicateurs d'émissions laser

Les témoins lumineux adéquatement identifiés sur le bloc d'alimentation et la tête du laser s'allument quand le bouton du laser est placé sur la position LASER ON avant que l'émission de laser puisse se produire. Des lampes blanches ou jaunes sont employées, afin qu'elles soient visibles lors du port de lunettes de sécurité.

Commandes fonctionnelles

Les commandes du laser sont placées de sorte que l'opérateur ne soit pas exposé à l'émission de laser lorsqu'il actionne ces commandes.

DANGER !
L'utilisation des commandes du système d'une manière autre que celle décrite ci-dessus peut altérer la protection fournie par le système, ayant comme conséquence des niveaux dangereux d'exposition de l'opérateur au rayonnement laser.

Compatibilité électromagnétique

Le système laser Paladin Advanced est conforme aux conditions européennes pour la compatibilité électromagnétique comme définies dans la Directive compatibilité électromagnétique 2004/108/EC.

Le laser Paladin Advanced est prévu pour un usage dans un environnement industriel. Le fonctionnement de ce système laser dans un environnement électromagnétique différent (résidentiel, par exemple) peut exiger que l'utilisateur prenne des mesures correctives en plus de l'installation, du fonctionnement et de l'entretien normaux décrits dans ce manuel pour résoudre des problèmes potentiels de compatibilité électromagnétique. Coherent ne sera pas tenu responsable au-delà des normes listées ci-dessous et concernant la compatibilité de ce système laser dans des environnements électromagnétiques autres qu'un environnement industriel.

Coherent Inc. déclare que le système laser Paladin Advanced répond aux exigences de la directive électromagnétique 2004/108/EC sur la base des normes suivantes :

- EN 50081-1, Emission, mars 1993
- EN 55022, Kl. B

- EN 61000-3-2, -3
- EN 61000-6-2, Susceptibilité, mars 1999
- EN 61000-4-2,-2, -4, -5, -6, -11
- EN 50204

Déchets d'équipements électriques et électroniques (2002)

La directive européenne sur les Déchets d'équipements électriques et électroniques (Waste Electrical and Electronic Equipment, WEEE) (2002/96/EC) est représentée par une étiquette de poubelle barrée (Étiquette UE Directive). L'objet de cette directive est de réduire au minimum l'élimination des Déchets d'équipements électriques et électroniques dans les flux non triés et de faciliter sa collecte séparée.

Directive batterie

Les batteries utilisées dans ce produit sont conformes à la Directive batterie de l'UE 2006/66/EC.

Table 1-5. Batteries contenues dans ce produit

DESCRIPTION	TYPE
12V rechargeable	Pb-acide

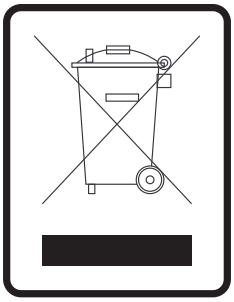


Figure 1-6. Étiquette UE Directive batterie

Éliminez les batteries selon les règlements locaux. Ne pas éliminer en tant que déchet normal. Consultez vos autorités locales pour plus d'informations.

Emplacement des étiquettes

Reportez-vous aux figures et aux tableaux suivants de ce chapitre pour connaître les emplacements et les descriptions de toutes les étiquettes. Ceux-ci incluent les étiquettes d'avertissement indiquant les carters de protection démontables ou remplaçables, les ouvertures par lesquelles le rayonnement de laser est émis et les marquages de certification et d'identification [CFR 1040.10(g), CFR 1040.2, et CFR 1010.3/ EN 60825-1, Clause 5]].

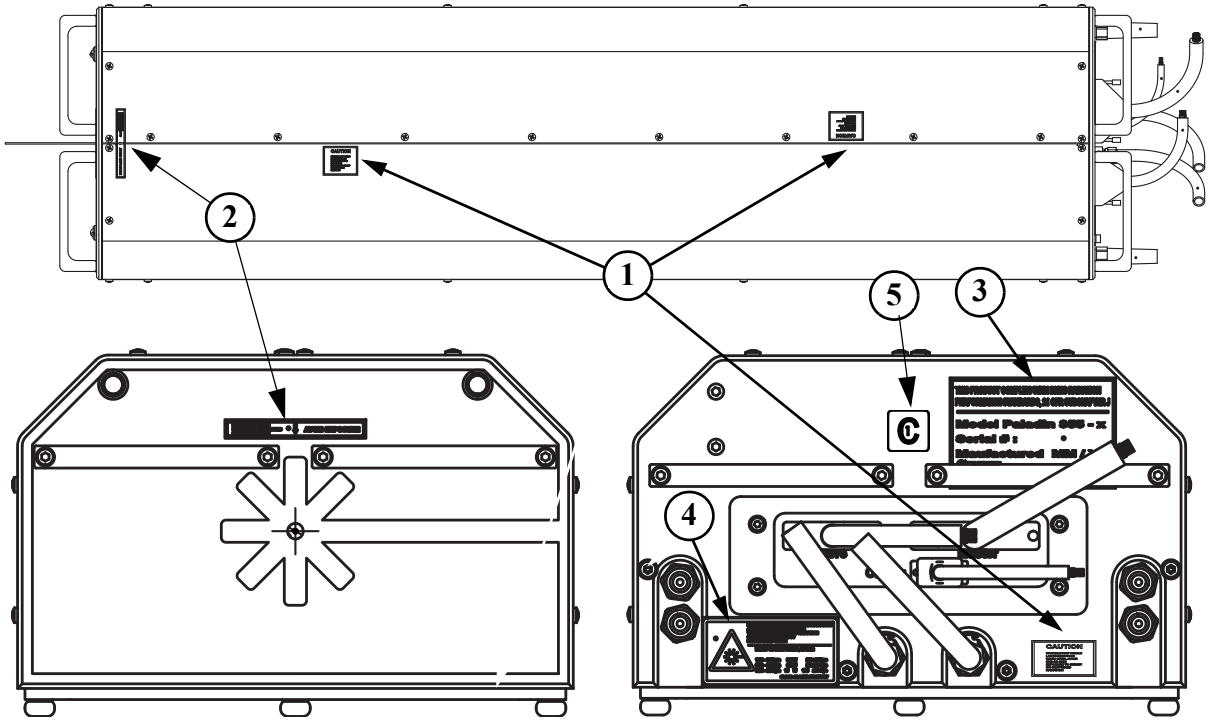


Figure 1-7. Emplacement des étiquettes sur la tête du laser

Table 1-6. Définitions des étiquettes - Tête

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
1.		Étiquette Attention : attire l'attention de l'utilisateur sur la possible exposition au rayonnement laser si le couvercle est enlevé. Le Paladin™ est un système laser de la classe IV. Il émet un rayonnement laser invisible et visible qui peut potentiellement endommager la peau ou l'œil. Cette étiquette est située sur le couvercle supérieur de la tête de laser et du bloc d'alimentation.
2.		Étiquette Éviter toute exposition : le Paladin™ est un système laser de la classe IV. Il émet un rayonnement laser invisible et visible qui peut potentiellement endommager la peau ou l'œil. Des avertissements sur le rayonnement laser sont ainsi placés sur la tête du laser où il est le plus susceptible de se produire une exposition de l'œil ou de la peau au rayon laser. Ceci inclut l'ouverture du laser et le panneau avant.
3.		Étiquette Produit: cette étiquette décrit la conformité aux normes DHHS Performance Radiation Standards 21 CFR Ch. I, EN 60825-1 pour ce produit. Elle contient également le modèle, le numéro de série, la date de fabrication, le numéro de pièce et l'origine du produit. Elle contient l'étiquette de la directive Déchets d'équipements électriques et électroniques (coin inférieur droit) : voir “Déchets d'équipements électriques et électroniques (2002)”à la page 1-24.

Table 1-6. Définitions des étiquettes - Tête

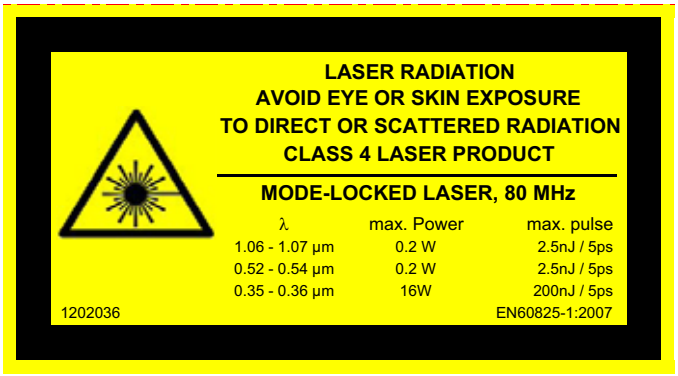
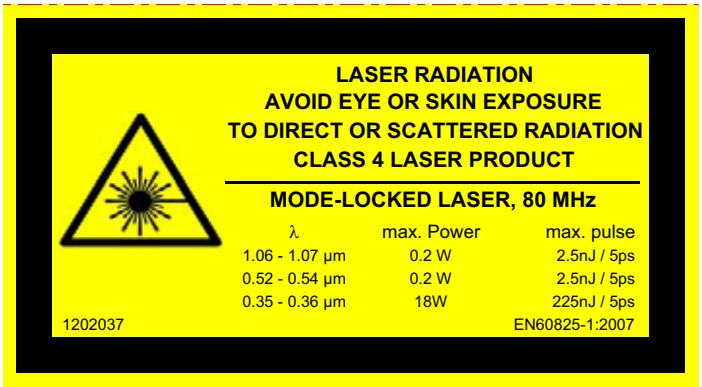
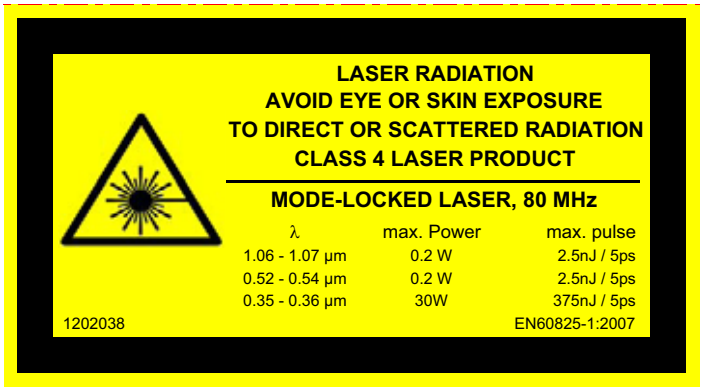
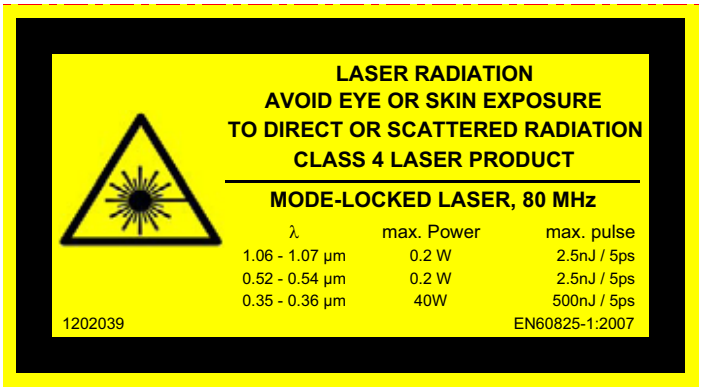
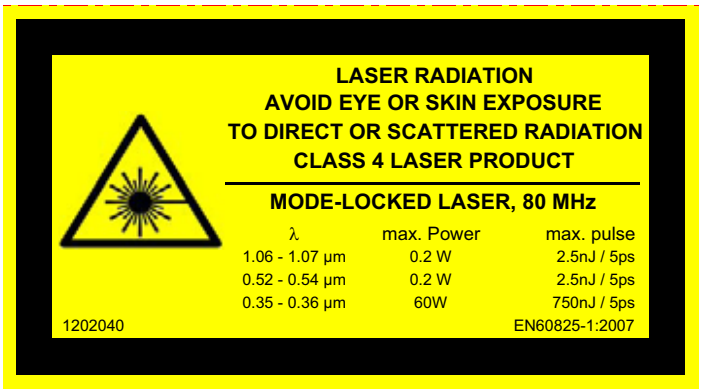
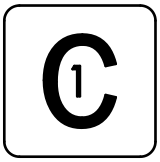
ÉLEMENT	ÉTIQUETTE	DESCRIPTION
4.	 Paladin ADVANCED 355-8000	Étiquette Produit Laser : cette étiquette décrit la longueur d'onde spécifique et les capacités de niveau de puissance de sortie de la tête du laser. Elle inclut également la classe laser du produit. Pour plus d'informations, se référer à “Classification du laser”à la page 1-22
4.	 Paladin ADVANCED 355-10000  Paladin ADVANCED 355-16000	Étiquette Produit Laser : cette étiquette décrit la longueur d'onde spécifique et les capacités de niveau de puissance de sortie de la tête du laser. Elle inclut également la classe laser du produit. Pour plus d'informations, se référer à “Classification du laser”à la page 1-22

Table 1-6. Définitions des étiquettes - Tête

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
	 Paladin ADVANCED 355-24000	
4.	 Paladin ADVANCED 355-35000	Étiquette Produit Laser : cette étiquette décrit la longueur d'onde spécifique et les capacités de niveau de puissance de sortie de la tête du laser. Elle inclut également la classe laser du produit. Pour plus d'informations, se référer à “Classification du laser”à la page 1-22
5.		Étiquette Canada-C1 : cette étiquette certifie que le produit a été testé aux conditions CAN/CSA-C22.2 No. 61010-1-12, deuxième édition, y compris l'amendement 1, ou une version postérieure de la même norme incorporant le même niveau de conditions d'essai.

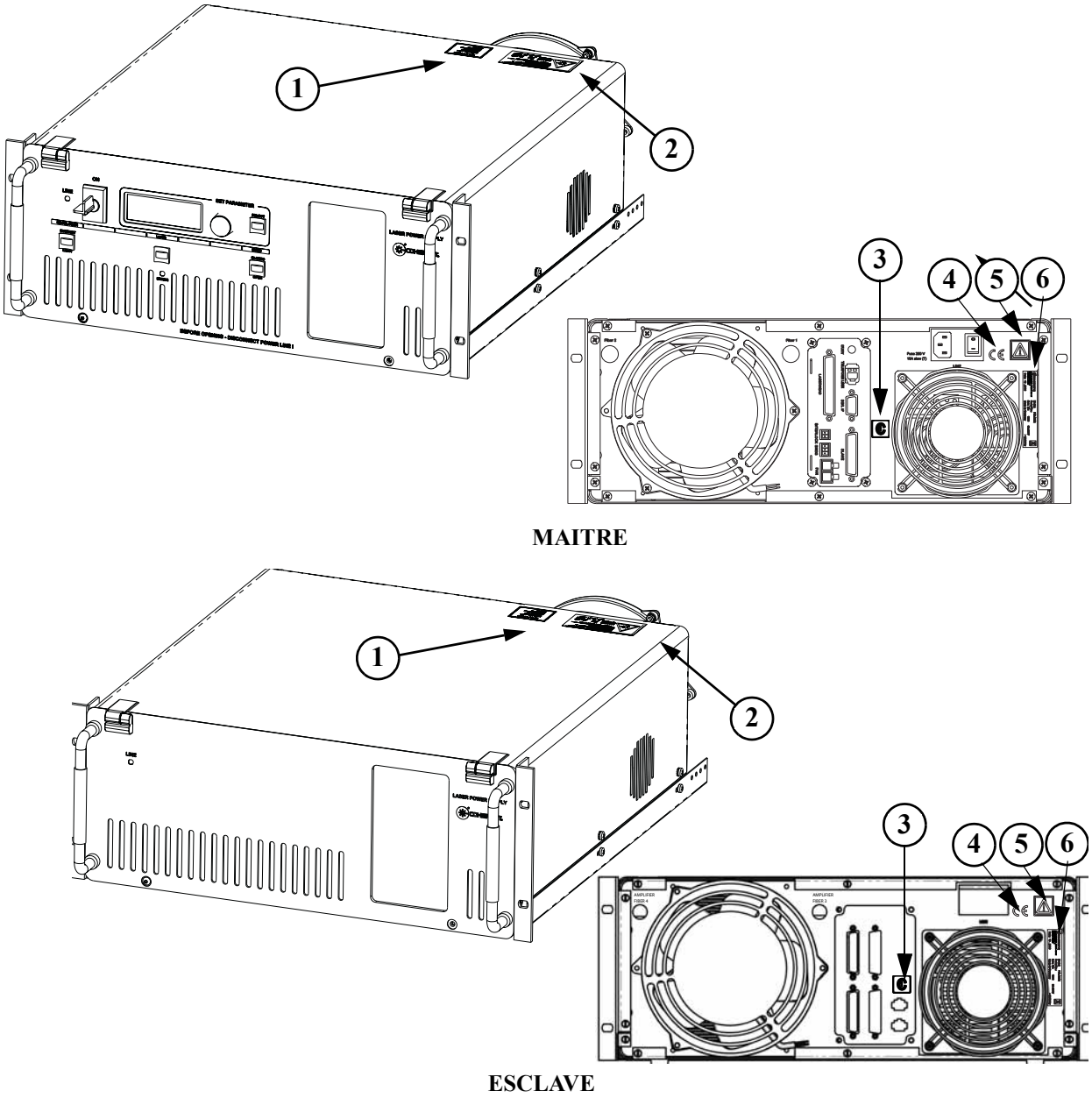


Figure 1-8. Emplacements des étiquettes - Alimentation

Table 1-7. Descriptions des étiquettes - Bloc d'alimentation

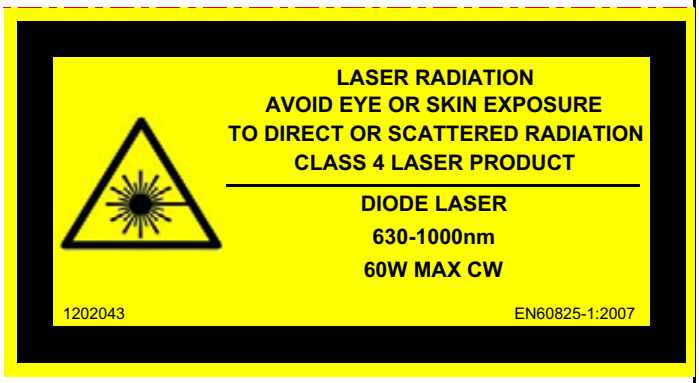
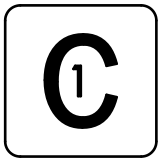
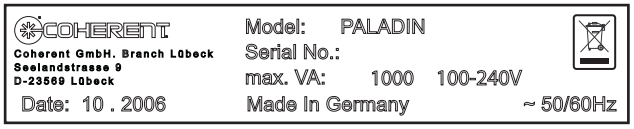
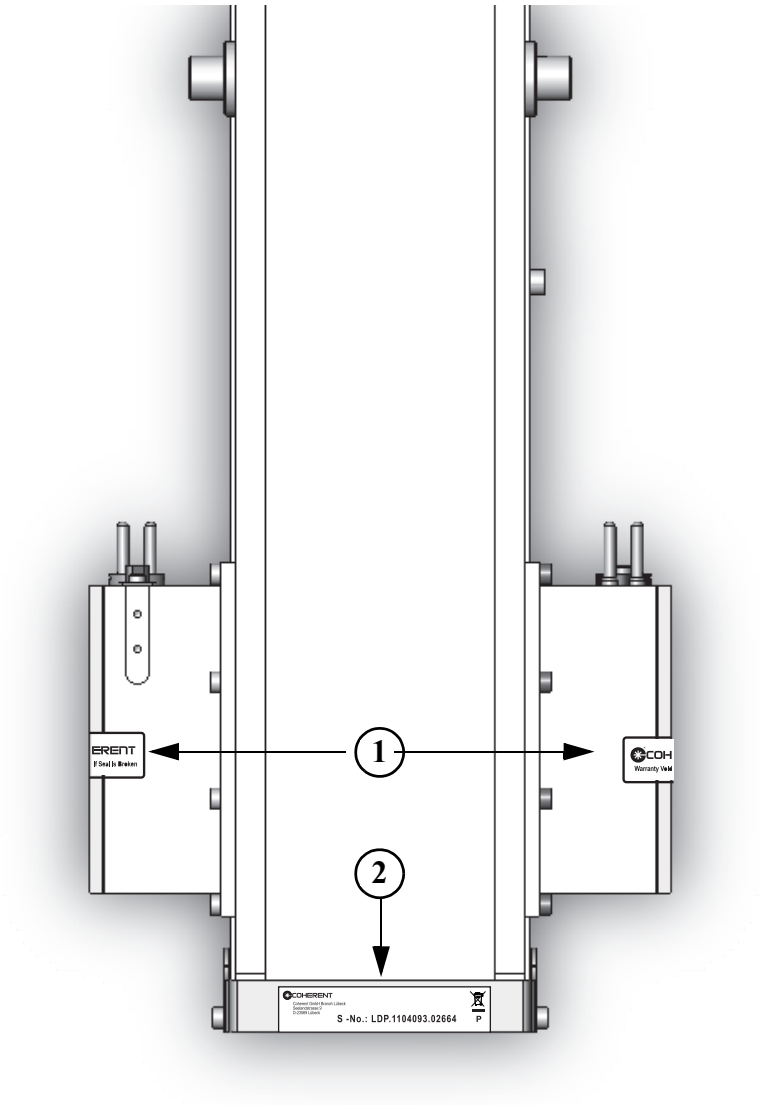
ÉLEMENT	ÉTIQUETTE	DESCRIPTION
1.		Étiquette Attention : attire l'attention de l'utilisateur sur la possible exposition au rayonnement laser si le couvercle est enlevé.
2.		Étiquette Produit à diode laser : cette étiquette décrit la longueur d'onde spécifique et les capacités de niveau de puissance de sortie des diodes lasers. Elle inclut également la classe de laser du produit. Pour plus d'informations, se aux “Dispositifs de sécurité et conformité avec les réglementations gouvernementales” à la page 1-20.
3.		Ce produit a été testé aux conditions CAN/CSA-C22.2 No. 61010-1-12, deuxième édition, y compris l'amendement 1, ou une version postérieure de la même norme incorporant le même niveau de conditions d'essai.
4.		Marquage Certification CE : conforme avec la Directive basse tension. Se référer à .“Dispositifs de sécurité et conformité avec les réglementations gouvernementales” à la page 1-20.

Table 1-7. Descriptions des étiquettes - Bloc d'alimentation (Continued)

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
5.		Identifie la présence d'instructions importantes sur l'utilisation et l'entretien. Attention nécessaire lors du travail à proximité du système.
6.		Étiquette Identification du bloc d'alimentation : contient la date de fabrication, le numéro de modèle, le numéro de série et l'origine du produit. Contient également le symbole relatif aux Déchets d'équipements électriques et électroniques décrit dans “Déchets d'équipements électriques et électroniques (2002)” à la page 1-24.



Vue de dessus du module de pompe (à l'intérieur du bloc d'alimentation)

Figure 1-9. Emplacement des étiquettes sur le module de pompe

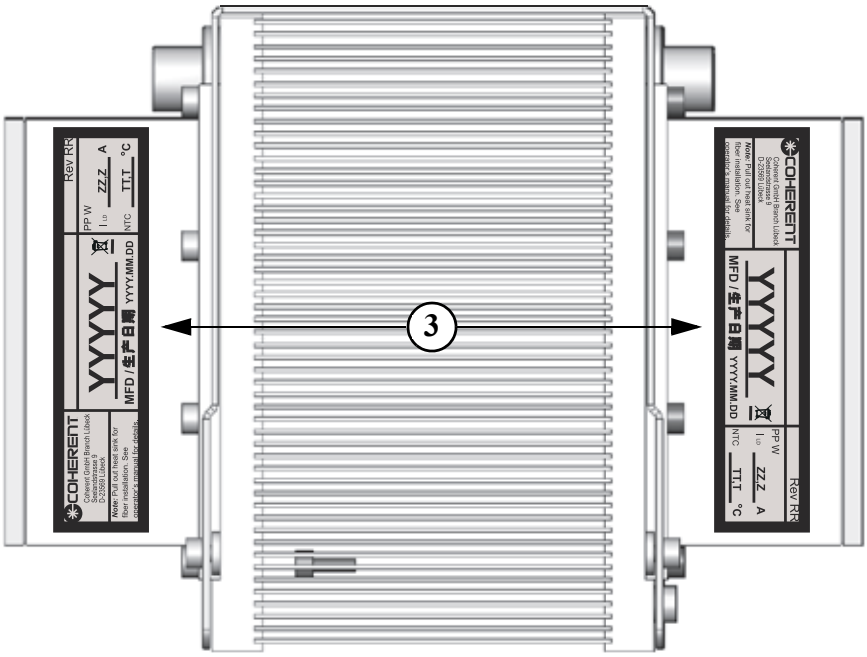


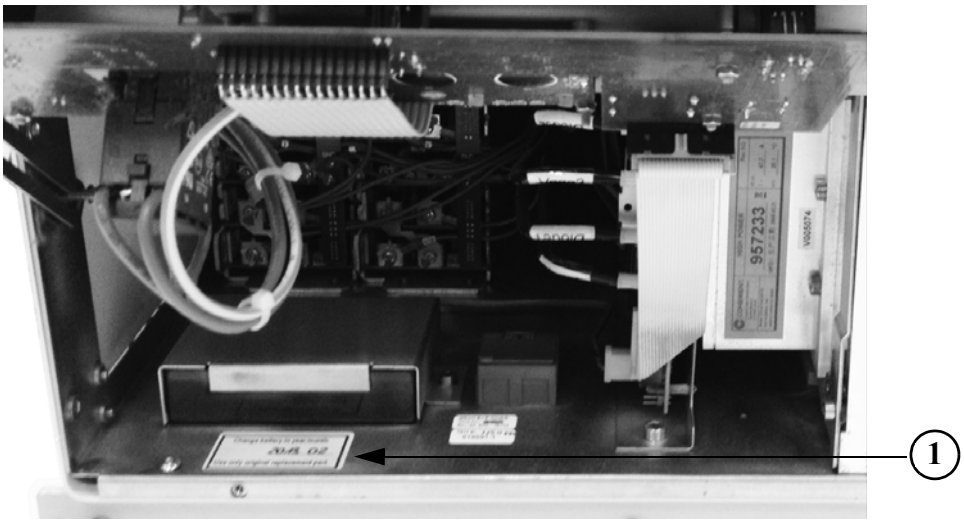
Figure 1-9. Emplacement des étiquettes sur le module de pompe (Continued)

Table 1-8. Définitions des étiquettes - Module de pompe

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
1.	COHERENT Warranty Void If Seal Is Broken	Étiquette de garantie : informe que la garantie du produit sera annulée si le sceau adhésif est brisé. Il est utilisé pour prévenir de tout accès non autorisé aux composants internes. Se référer à la partie " Garantie " à la page B-1.

Table 1-8. Définitions des étiquettes - Module de pompe (Continued)

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
2.		Étiquette Numéro de série du module de pompe : contient le numéro de série et l'origine du produit. Contient également le symbole relatif aux Déchets d'équipements électriques et électroniques décrit dans “Déchets d'équipements électriques et électroniques (2002)” à la page 1-24.
3.		Étiquette d'identification pour le module de pompe : contient la date de fabrication, le numéro de modèle, le numéro de série et l'origine du produit. Contient également le symbole relatif aux Déchets d'équipements électriques et électroniques décrit dans “Déchets d'équipements électriques et électroniques (2002)” à la page 1-24.

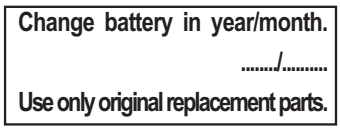


À l'intérieur du bloc d'alimentation

À l'intérieur de la tête du laser (cadre avant retiré)

Figure 1-10. Emplacement des étiquettes internes

Table 1-9. Définitions des étiquettes - Étiquettes internes

ÉLEMENT	ÉTIQUETTE	DESCRIPTION
1.		Étiquette Batterie : le bloc d'alimentation contient une batterie pour contrôler le refroidissement de la tête du laser. Cette étiquette est située dans le bloc d'alimentation à côté de la batterie et précise la date de remplacement préconisée de la batterie.
2.		Étiquette Dessiccatif : indique la date de remplissage et d'installation du récipient de dessiccatif. Les étiquettes sont sur fond jaune, l'impression est en noir. L'étiquette est située à l'arrière du récipient de dessiccatif.

SECTION TWO: DESCRIPTION AND SPECIFICATIONS

System Description

The Paladin Advanced laser is a diode-pumped solid-state mode-locked laser that emits ultra violet (355 nm) output with pulse repetition rates in the 80 MHz region and pulse lengths around 15 ps. Specifications for the Paladin Advanced are given in Table 2-1 through Table 2-4.

The Paladin Advanced laser consists of the laser head and one (or two) power supplies connected by electrical and fiber optic cables. The fiber optic cables transmit light from the diode bars in the power supply to the laser head. The system also has a closed loop water-to-air chiller that keeps the laser head at a stable temperature at 28°C (82°F), and 18°C (64°F) for higher power 16 and 24 W models.

Laser Head

The laser head contains the optical elements, a circuit board, and a shutter. The major optical elements in the hermetically sealed head include a proprietary crystal set as the gain medium, a crystal as a second harmonic generation (SHG), and an additional crystal as a third harmonic generation (THG). All optical components are mounted on a kinematically mounted resonator for strength and stability.

The temperature of the gain medium is controlled by TECs (thermo-electric coolers) capable of heating or cooling the optical element. The temperatures of the SHG and THG crystals are set to approximately 150°C and 60°C (302°F and 140°F), respectively. The harmonic crystals are controlled and kept stable by ovens. Accumulated heat in the laser head is dissipated through the water cooled base-plate of the housing. The CPU in the power supply monitors the base-plate temperature. The CPU will stop the system if the laser head temperature increases above35°C.

The laser head gain medium is used in an end-pumped geometry, with the pump power provided by fiber-delivered diode bars. The distal ends of the two (or four) optical fibers are imaged into the gain medium.

Power Supply

The main function of the power supply is to provide DC power to:

- Control system parameters
- Monitor and diagnostic functions

The power supply serves as a user interface. The pump diodes and all servo loops for the thermal management are also controlled through the power supply.

A description of the servo loops controlled by the CPU is given below.

SHG/THG temperature

The crystals in the THG and in the SHG are held at preset temperatures by ovens. The crystal in the SHG oven is sensitive to fast changes in temperature because of the optical coatings on the crystal. The CPU slowly increases the temperature of the crystals to operating temperature. Allow a minimum of 30 minutes to reach operating temperature. In case of loss of AC power because of a power failure or accidental shut-down, the laser has a battery-powered, CPU controlled cool-down feature. The cool-down feature lowers the SHG crystal temperature gradually to room temperature.

An automatic optimization feature is available for both crystal temperatures. It is recommended to operate the laser with these features activated.

Diode Pump Module heat sink temperature

The diode pump module operating temperature is held constant by TECs. Excess heat is dissipated by forced air cooling through heat sinks. The pump module is located within the power supply.

Gain medium temperature

The vanadate temperature is maintained at a preset level by a TEC.

Laser Diode Assembly

The hermetically sealed laser diode assembly contains a FAP-B™ (Fiber Array Package), a circuit board with an EEPROM, and a heat sink sensor.

NOTICE!
The laser diode assembly has a safety switch that disables operation when the fiber optic cable is disconnected.

The FAP-B consists of a laser diode bar with collection and symmetrizing optics mounted within an environmentally sealed package. The FAP-B efficiently converts low-voltage, high-current electrical power into a circularly-symmetric, multi-mode laser beam. The FAP-B is designed to operate under continuous wave (CW) operating conditions at high, multi-watt output powers for thousands of hours. Waste heat from the laser diode bar is transferred through the FAP-B base to a heat sink.

The FAP-B contains a laser diode bar that efficiently converts electrical energy into optical laser energy. The laser diode bar consists of a multiplicity of independent emitters spaced linearly along a single semiconductor substrate. The output of each of these emitters is captured by a collecting optical fiber. This linear array of fibers is then bundled into a circularly symmetric output.

At low drive currents, the laser diode bar will have insufficient gain to lase. In this operating regime, some light, originating from spontaneous emission will be visible. As the drive current is increased, the laser diode bar will reach threshold, where it will have sufficient gain to lase. This drive current is the threshold current. Further increases in current will cause a linear increase in output optical power, up to the specified operating power.

In general, semiconductors devices perform better at lower operating temperatures. The electrical-to-optical conversion efficiency is higher and the device lifetime is longer. It is desirable to operate the FAP-B at low temperatures (consistent with observing the specified operating temperature limits) to improve device performance and lifetime.

However, the precise semiconductor operating wavelength is a function of operating temperature. Control of the temperature is extremely important to bring the wavelengths of the diodes within the absorption window of the gain medium.

Diode/Heat Sink Temperature

The laser diode assembly that houses the FAP-B is mounted on a finned heat sink. The TEC controls the temperature of the diode bars in the FAP-B. Waste heat from the diode bars is transferred to the passive heat sink.

The heat sink is cooled by fans that remove waste heat from the laser diode assembly to the outside of the power supply. Incoming ambient air is filtered by an air filter that can be cleaned periodically depending on the environment.

The laser diodes have an operating temperature range of 15°C to 35°C (59°F to 95°F).

Thermal Management of the Laser Head

Water Cooling

The laser diode pump power delivered to the laser head is absorbed by the vanadate gain medium inside the laser head. The crystal is kept at a stable temperature by TEC modules. The energy that is not converted into laser light is dissipated as heat to the baseplate of the laser. Additional heat is generated inside the laser by the ovens containing the crystals for second harmonic generation (SHG) and third harmonic generation (THG) and a beam dump that converts the unused IR and green power into heat.The amount of heat generated inside the laser head is in the range of 150 W and must be removed.

Due to the high pointing stability requirements of some applications, an air cooling solution is not possible. In an air-cooled system, the temperature of the laser housing changes with ambient temperature. Changes in ambient temperature causes beam pointing fluctuation during operation that exceeds the current system specifications. For this reason, a closed loop water cooling system was selected to remove the heat from the laser head.

Chiller

The chiller supplied by Coherent is set to provide a pressure of 1.5 bar (22 PSI) for a 5 m (16.4 ft.) tube. If a longer tube is required, change the pressure inside the chiller. Contact your local Coherent support representative for additional information.

NOTICE!
A cooling line pressure greater than 2 bar (29 PSI) can cause damage to the Paladin Advanced laser head seals and optical components.

Other chillers that meets the specifications of the chillers supplied by Coherent may be used with the Paladin Advanced laser system. Refer to the chiller manual for details.

NOTICE!
Confirm that an overpressure safety mechanism is installed to prevent damage to the laser head seals and optical components.

Specifications and Requirements

System Specifications

Specifications for the Paladin Advanced Mode Locked UV laser system are given in Table 2-1.

Table 2-1. Performance Specifications

PARAMETER	SPECIFICATION
Wavelength (nm)	355
Output Power[1] (W) Paladin Advanced 355-8000	8
Paladin Advanced 355-10000	10
Paladin Advanced 355-16000	16
Paladin Advanced 355-24000	24
PaladinAdvanced 355-35000	35
Repetition Rate (MHz) Paladin Advanced 8000/10000/16000	80 ± 1 MHz
Paladin Advanced 24000	82 ± 1 MHz
Paladin Advanced 35000	80 ±5 MHz
Pulse Length (ps)	> 15 @ 1064 nm
Spatial Mode	TEM_{00}
M^2	< 1.2
Beam Diameter (mm) Paladin Advanced 355-8000/10000	1 ± 15%
Paladin Advanced 355-16000/24000/35000	1.35 ± 15%
Beam Divergence (µrad) Paladin Advanced 8000/10000	< 550
Paladin Advanced 16000/24000/35000	< 480
Beam Ellipticity	0.9 to 1.1
Pointing Stability (µrad/°C)	< 20
Polarization	linear > 100:1, vertical
Noise (10 Hz to 2 MHz)	< 1% (rms)
Long-term Power Stability	< ± 2%

Table 2-1. Performance Specifications (Continued)

PARAMETER	SPECIFICATION
Maximum Warm-up Time	< 15 min. from standby < 1 hour from cold start
Static Tolerances (Reference from feet of the laser)	
Beam Position:	< ± 0.5 mm (x,y)
Beam Angle:	< ± 2.5 mrad
(1) Power not adjustable.	

Utility Requirements

The utility requirements for the Paladin Advanced laser system are given in Table 2-2.

Table 2-2. Utility Requirements

OPERATING VOLTAGE			
Power Supply:	100-240 VAC, 50 to 60 Hz		
Chiller:	115/230 VC (switchable), 50/60 Hz		
POWER CONSUMPTION			
	Maximum	Operation (typical)	Standby (typical)
Power supply:	1000 VA	350 VA	200 VA
Chiller (8W/10W)	1000 VA	500 VA (22°C [71.6°F] ambient)	500 VA (22°C [71.6°F] ambient)
Chiller (16W/24W/35W)	1600 VA	750 VA (22°C ambient)	750 VA (22°C ambient)
Maximum ambient temperature: +35°C (95°F), Head temperature stabilized by the chiller.			

Dimensions and Weights

System dimensions and weights for the Paladin Advanced laser system are shown in Table 2-3. Refer to the Controls and Indicators subsection below for the graphical representations of the system dimensions.

Table 2-3. Dimensions and Weights

DIMENSIONS		
Laser head:	305 x 200 x 1100 mm^3 (12 x 7.9 x 43.3 $in.^3$) (+ 300 for fibers & connectors)	
Power supply:	482 x 177 x 505 mm^3 (19.0 x 7.0 x 19.9 $in.^3$) (19 inch rack mountable)	
Chiller:	8/10W Advanced:	482 x 177 x 560 mm^3 (19.0 x 7.0 x 22.0 $in.^3$) (19 inch rack mountable)
	16/24/35 W Advanced:	482 x 266 x 640 mm^3 (19 x 10.5 x 25.2 in^3)
Pump fiber length:	5 m (16.4 ft.) 2-fibers @ 8/10 W 4-fibers @ 16/24 W 6-fibers @ 35W	
WEIGHTS		
Laser head:	50 kg (110.2 lb.)	
Power supply (master and slave):	30 kg (66 lb.)	
Chiller:	8/10W Advanced	38 kg (83.8 lb.) + 3 liters (.79 gal.) coolant
	16/24/35W Advanced	42 kg (92.6 lb) + 2 liters (.53 gal.) coolant

Environmental Requirements

The Environmental requirements for the Paladin Advanced laser system are provided in Table 2-4.

Table 2-4. Environmental Requirements

	OPERATING	NON-OPERATING
Temperature:	15°C to 35°C (59°F to 95°F)	below - 25°C or above 60°C (below -13°F or above 140°F)
Altitude:	0 to 3048 m (10,000 ft.)	above 13700 m (40,000 ft.)
Relative Humidity: (non-condensing)	0 to 90 %	above 90 %
Shock:	N/A	< 10 G

Dimensional Drawings

Figure 2-1 and Figure 2-2 show dimensions of the Paladin Advanced head and power supply. The 8000 and 10000 lasers will require one power supply. The 16000 and 24000 requires two power supplies. The 35000 requires three power supplies.

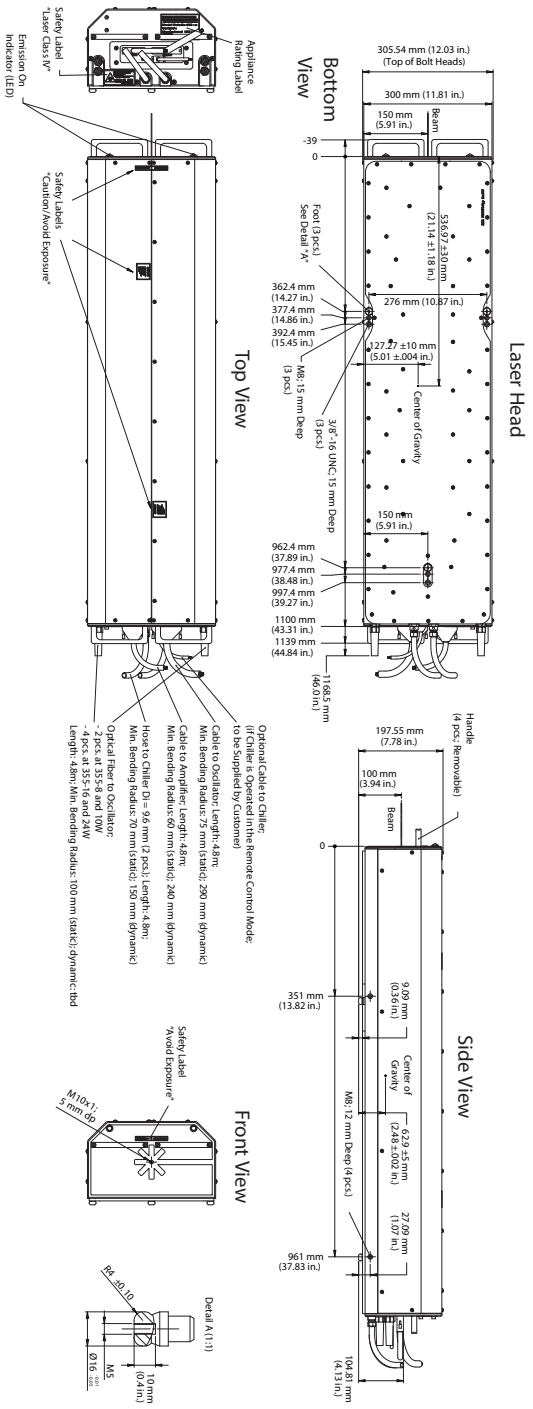
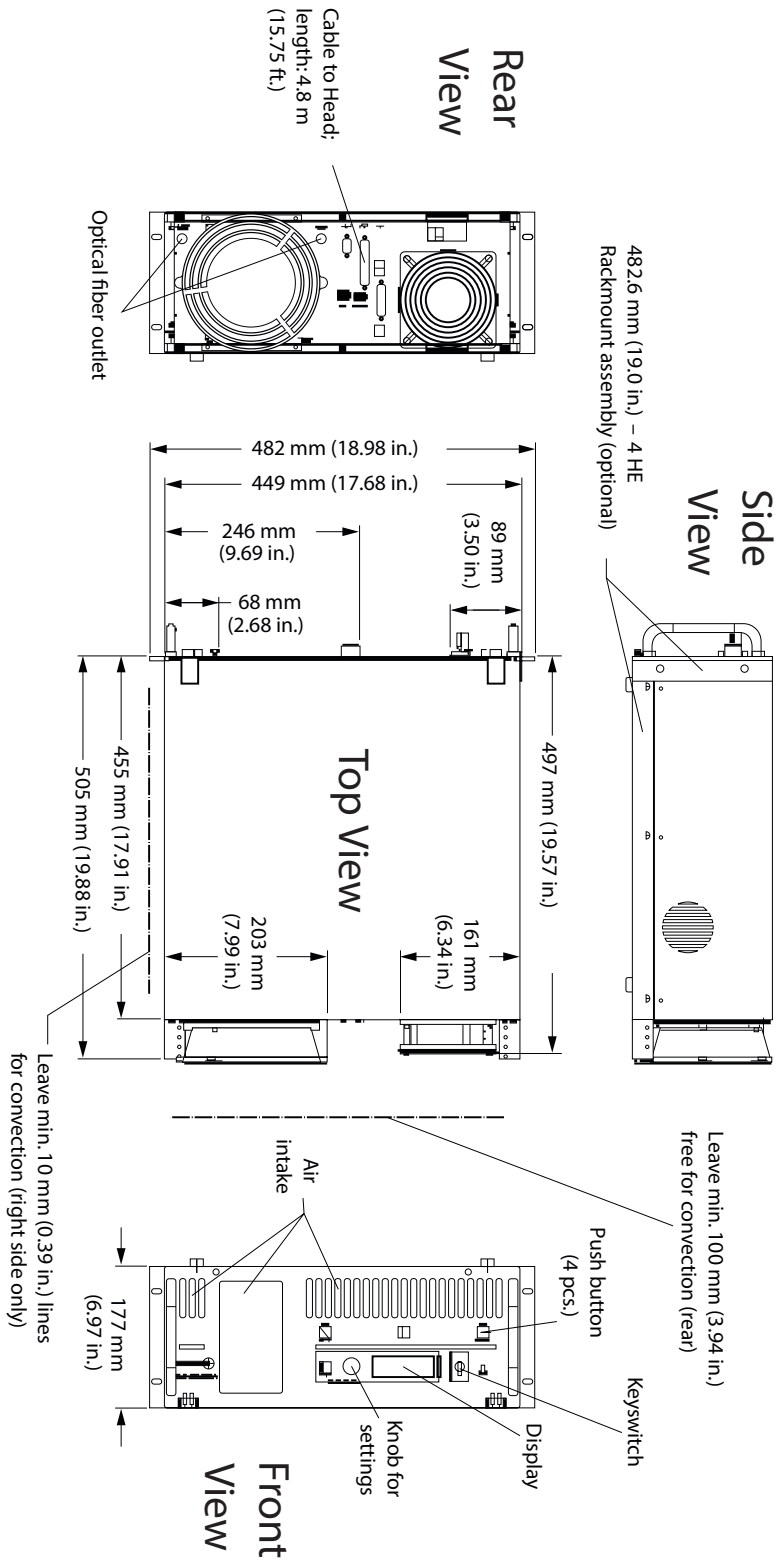

Safety Label "Laser Class IV"
Emission On Indicator (LED)
Appliance Rating Label
Safety Labels "Caution/Avoid Exposure"
Top View
Bottom View
305.54 mm (12.03 in.) (Top of Bolt Heads)
300 mm (11.81 in.)
150 mm (5.91 in.)
Beam
-39
0
Foot (3 pcs.) See Detail "A"
536.97 ±0.mm (21.14 ±1.18 in.)
362.4 mm (14.27 in.)
377.4 mm (14.86 in.)
392.4 mm (15.45 in.)
276 mm (10.87 in.)
127.27 ±10 mm (5.01 ±.004 in.)
M8; 15 mm Deep (3 pcs.)
3/8"-16 UNC; 15 mm Deep (3 pcs.)
Center of Gravity
Laser Head
150 mm (5.91 in.)
962.4 mm (37.89 in.)
977.4 mm (38.48 in.)
997.4 mm (39.27 in.)
1100 mm (43.31 in.)
1139 mm (44.84 in.)
1168.5 mm (46.0 in.)
Optical Fiber to Oscillator: - 2 pcs. at 355-8 and 10W - 4 pcs. at 355-16 and 24W Length: 4.8m; Min. Bending Radius: 100 mm (static); dynamic- tbd
Hose to Chiller; Di = 9.6 mm (2 pcs.); Length: 4.8m; Min. Bending Radius: 70 mm (static); 150 mm (dynamic)
Cable to Amplifier; Length: 4.8m; Min. Bending Radius: 60 mm (static); 240 mm (dynamic)
Cable to Oscillator; Length: 4.8m; Min. Bending Radius: 75 mm (static); 200 mm (dynamic)
Optional Cable to Chiller; (if Chiller is Operated in the Remote Control Mode; to be Supplied by Customer)
197.55 mm (7.78 in.)
Handle (4 pcs; Removable)
100 mm (3.94 in.)
Beam
0
351 mm (13.82 in.)
9.09 mm (0.36 in.)
Center of Gravity
M8; 12 mm Deep (4 pcs.)
6.29 ±.5 mm (2.48 ±.02 in.)
27.09 mm (1.07 in.)
961 mm (37.83 in.)
104.81 mm (4. 13 in.)
Side View
Safety Label "Avoid Exposure"
M10x1; 5 mm dp
Front View
R4 ±0.10
Detail A (1:1)
Ø16
M5
10 mm (0.4 in.)

Figure 2-1. Laser Head


Rear View
Cable to Head; length: 4.8 m (15.75 ft.)
Optical fiber outlet
Side View
482.6 mm (19.0 in.) – 4 HE Rackmount assembly (optional)
482 mm (18.98 in.)
449 mm (17.68 in.)
246 mm (9.69 in.)
89 mm (3.50 in.)
68 mm (2.68 in.)
Top View
455 mm (17.91 in.)
505 mm (19.88 in.)
497 mm (19.57 in.)
203 mm (7.99 in.)
161 mm (6.34 in.)
Leave min. 10 mm (0.39 in.) lines for convection (right side only)
Leave min. 100 mm (3.94 in.) free for convection (rear)
Air intake
Push button (4 pcs.)
Keyswitch
177 mm (6.97 in.)
Knob for settings
Display
Front View

Master and slave power supplies have identical dimensions. The slave power supply does not have a display and the connections in the back differs from the master. See “Section Two: Description and Specifications” on page 2-1.

Figure 2-2. Power Supply

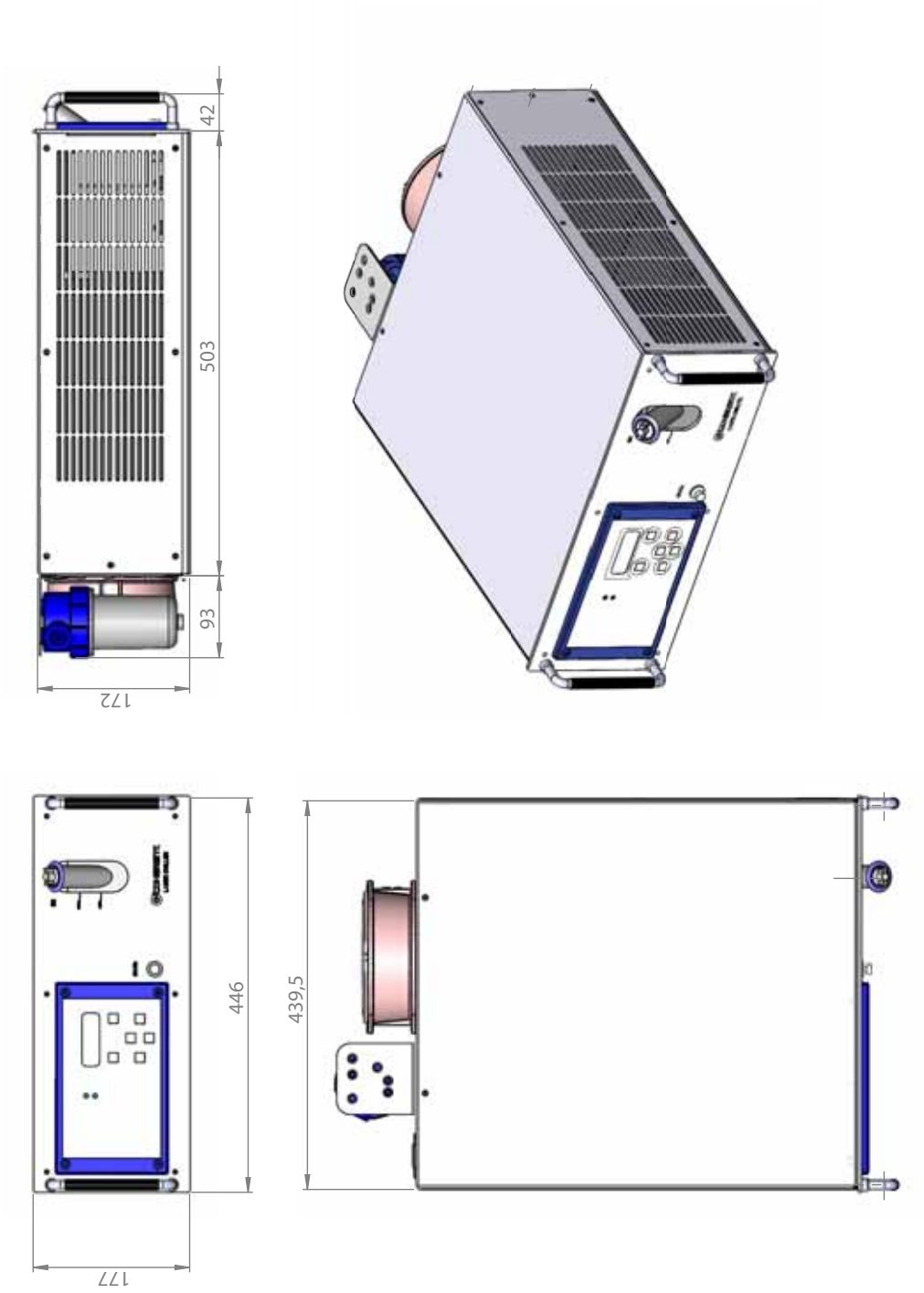


Figure 2-3. Termotek Chiller 302-17227 (for 8W-10W Systems)

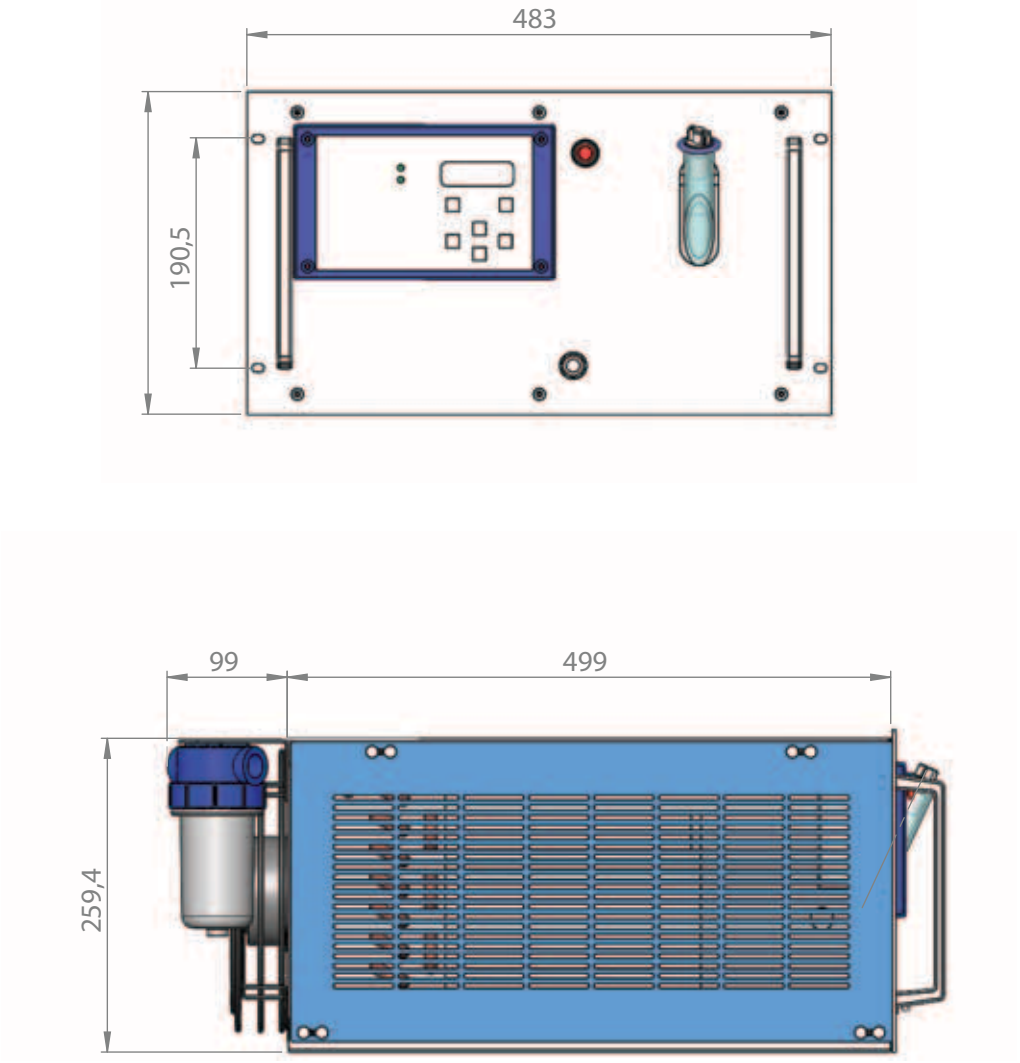


Figure 2-4. Termotek Chiller P307-16273 (for 16W-35W Systems)

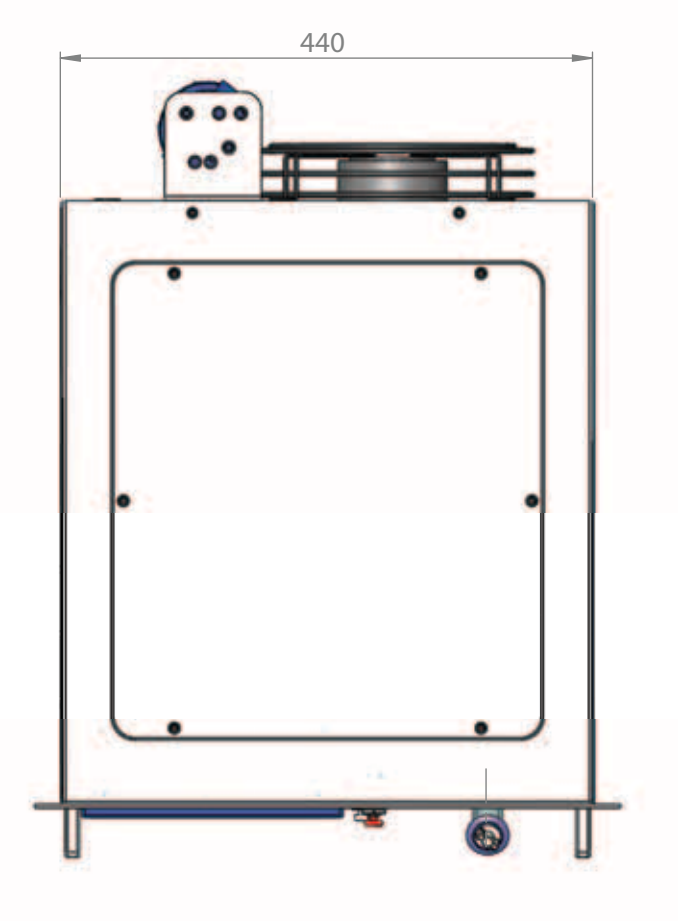


Figure 2-4. Termotek Chiller P307-16273 (for 16W-35W Systems) (Continued)

SECTION THREE: INSTALLATION

Installation Procedure

To keep the factory warranty, a Coherent certified engineer must install the Paladin Advanced laser system. The procedures that follow are given for the customer to install the laser after the warranty has expired.

See "Section Four: Controls, Indicators and Features" on page 4-1, for the location of items referred to in the installation procedures. User is responsible to review "Section One: Safety" and research local safety regulations to confirm compliance before installation.

If the power supply(s) and/or chiller need to be installed on a rack, install the mounting hardware first. After the mounting hardware is installed, secure the assemblies in the rack. Only start "System Setup" after the assemblies are secured in the rack. See "Installation of Rack-Mount Options" on page 3-27 for instructions for hardware to be rack-mounted.

Shipping Container Inspection

Inspect the SHOCKWATCH® and TILTWATCH™ indicators attached to the power supply and laser head crates (Figure 3-1) before system is removed from the crate. If a color change appears on one or both of these indicators, contact the shipping company and a Coherent Service representative. Report possible problems.

SHOCKWATCH -ÜBERWACHUNG
SHOCKWATCH -MONITORED SHIPMENT
SHOCKWATCH -CONTRÔLE TRANSPORT
1. Ne pas refuser le colis.
2. Indiquer sur le bordereau que le label est déclenché. Vérifier les dégâts éventuels.
3. En cas de dégâts, émettez des réserves circonstanciées par lettre recommandée auprès du transporteur.
Si le choc-label est ROUGE
1. Verweigern Sie nicht die Annahme.
2. Vermerken Sie roten Indikator auf dem Transportschein und überprüfen Sie die Ware sofort auf Schäden.
3. Wenn Schäden aufgetreten sind, lassen Sie alles original verpackt und fordern Sie umgehend Schadensinspektion vom Transporteur.
Wenn der Indikator ROT ist
1. Do not refuse shipment.
2. Make notation on delivery receipt and inspect for damage.
3. If damage is discovered, leave in original container and packaging, and request immediate inspection from carrier within 3 days of delivery.
If Shockwatch indicator is RED
WARNING
HANDLE WITH CARE
VORSICHT
SHOCKWATCH®
SHOCKWATCH®
TILTWATCH
-ÜBERWACHUNG
-CONTRÔLE TRANSPORT
-MONITORED SHIPMENT
AUFRECHT TRANSPORTIEREN
TENIR DEBOUT
KEEP UPRIGHT
ATTENTION
CAUTION
148104
VORSICHT

SHOCK WATCH TILT WATCH

Figure 3-1. Shipping Label Indicators

Installation Checklist

The following is the Installation Checklist for the Paladin Advanced laser system. This checklist is a quick reference guide for an end-user with experience. Complete procedures follow.

[ ] Confirm SHOCKWATCH® and TILTWATCH™indicators have not changed color.

[ ] Lift master power supply front panel.

[ ] Pull master pump module out to access FAP connectors.

[ ] Insert capped fiber 1 and 2 through the holes on the rear panel of master power supply.

[ ] Clean end of the first fiber according to cleaning procedure.

[ ] Attach fiber 1to FAP-B #1.

[ ] Clean end of the fiber 2 according to cleaning procedure.

[ ] Attach fiber 2 to FAP-B #2.

[ ] Open slave power supply front panel (16/24/35W system).

[ ] Pull the pump module out of the slave power supply to access FAP connectors (16/24/35W system).

[ ] Insert capped fiber 3 to 6 through the holes on rear panel of slave power supplies (16/24/35W system).

[ ] Clean third fiber according to fiber cleaning procedure. (16/24/35 W System).

[ ] Attach fiber 3 to FAP-B #3 (16/24/35 W System).

[ ] Clean fiber 4 according to fiber cleaning procedure (16/24/35 W System).

[ ] Attach fiber 4 to FAP-B #4 (16/24/35 W System).

[ ] Clean fiber 5 according to fiber cleaning procedure. (35 W System).

[ ] Attach fiber 5 to FAP-B #5 (35W System)

[ ] Clean fiber 6 according to fiber cleaning procedure. (35 W System).

[ ] Attach fiber 6 to FAP-B #6 (35W System)

[ ] Remove the grounding clips

[ ] Push the pump module(s) inside the power supply(s)

[ ] 24W system: Attach power connectors to the pins found on the front of the pump modules.

[ ] Close the front panel and tighten the screws.

- [ ] Connect and secure the “Head Cable” between the power supply and the laser head.
- [ ] Connect and secure the cable between master and slave power supply (16/24/35 W System).
- [ ] Connect and secure the slave cable between slave power supply and laser head (16/24/35 W System).
- [ ] Connect serial cable between laser head and chiller.
- [ ] Connect and secure slave power cable and slave control cable between both slave power supplies (35 W).
- [ ] Connect the power supplies to the facility power.
- [ ] Turn the power supply keyswitch to the On position.
- [ ] Install fiber cable in tool.

System Unpacking

The system comes in three or four (for 16/24 W system) or five (for the 35W system) separate crates. The laser head, chiller and power supplies come in separate crates. Remove the contents from the crates as shown below. Check the content of each shipping crate with “Parts List” on page 4-1.

NOTICE!
Keep the shipping containers. Use only the original containers if the system is returned to the factory for service. The containers can be required as evidence in a shipping damage claim.

Laser Head

1. Remove the binder straps. Use a two-person lift to carefully lift the top cover from the head shipping crate.
2. Find the accessories box at the connector end of the laser. The contents of the accessories box include: Cables, power cords and the optical cleaning kit. Remove the accessories box to find the optical fiber (see Figure 3-2).

NOTICE!
Always keep a bend radius greater than 15 cm for the fiber cables. A bend radius less than 15 cm will cause damage to the fiber and laser head.

LASER HEAD

ACCESSORY BOX AND CABLES

COILED FIBER

Figure 3-2. Head Shipping Crate

3. Remove the polyethylene cover from the laser head. Carefully lift the fiber coil from the cushion and position on-top of the head.
4. Use a two-person lift to lift the head and fiber cables out of the crate.
5. Put the laser on the installation surface and secure.

Power Supply(s)

1. Remove the plastic or metal straps from the crate. Use a two-person lift to remove the wooden cover (see Figure 3-3).

Opening the Power Supply Crate

Power Supply with Foam Cushions

Figure 3-3. Power Supply Shipping Crate

2. Lift the power supply from the base and remove the foam cushions.
3. If the power supply is to be rack-mounted, install the rack-mount hardware at this time. Refer to "Installation of Rack-Mount Options" on page 3-27 for instructions.
4. Put the power supply(s) down where it will be operated.

Chiller

One of two different chiller models below will be sent with the system.

8/10 W uses P302-17227.

16/24/35 W uses P307-16273.

1. Lift the top cover off the chiller crate (see Figure 3-4). Do not turn the chiller upside down while you remove it from the crate.

NOTICE!
The chiller must be kept in a horizontal position. Too much tilting or setting the chiller upside down can damage the unit. The chiller must always be transported on a pallet to prevent damage.

CHILLER CRATE **CHILLER CRATE (COVER REMOVED)**

Figure 3-4. Packaged Chiller

2. If the chiller is to be rack -mounted, install the mounting hardware at this time. Refer to "Installation of Rack-Mount Options" on page 3-27 for instructions.
3. Put the chiller where it will be operated before the connections to the laser head are made and Nalco™ is added.

System Setup

Selection of the Chiller Line Voltage for Paladin 8W/10W

To adjust the chiller for the Paladin 8W/10W for the local line voltage, see instructions below.

1. Open panel on the left side of the chiller, to access the voltage selection terminal.

   Two plugs are supplied for different voltage applications (120 or 230 V). The two plugs are attached. The factory set voltage is 230V (see Figure 3-5).
2. Confirm the plug with the correct voltage is in the terminal.
3. If the incorrect plug is in the terminal, replace the plug with the other plug. Rotate the plug to match the pin-out of the connector in the terminal.

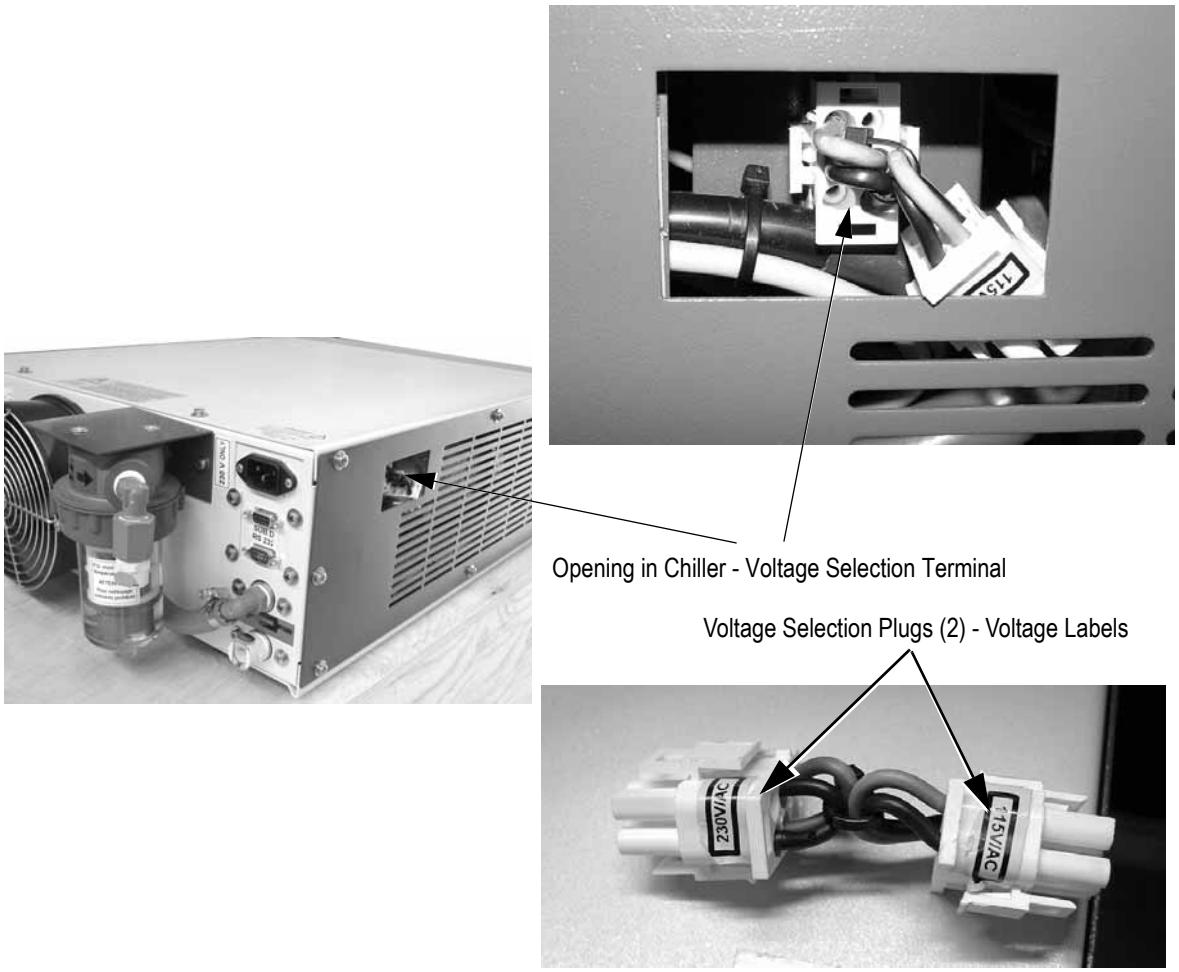


Figure 3-5. Chiller Voltage Selection Terminal with Voltage Selection Plugs

DANGER!
Keep power cord to the chiller disconnected when you fill the chiller to prevent electrical shock.

Selection of the Chiller Line Voltage for Paladin 16/24/35 W

To adjust the chiller for the Paladin 16/24/35 W chiller for the local line voltage, see instructions below. The standard setting is 230V.

1. Turn off the chiller and disconnect the power cable.
2. Carefully remove the left panel so that the ground connector attached to the panel, does not come off.
3. Disconnect the 230V-voltage plug from the internal connector.
4. Remove the female connection protector from the required voltage connector (voltage is marked on the connector).
5. Connect the voltage connector to the internal connector.
6. Attach the female connection protector to the 230V voltage plug.
7. Connect ground cable to side panel. Attach side panel to chiller housing.
8. Remove 230V label located at rear of chiller. Replace with label of selected voltage type.

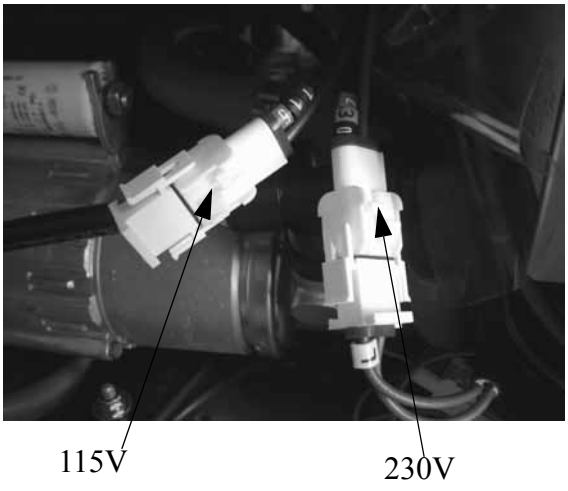
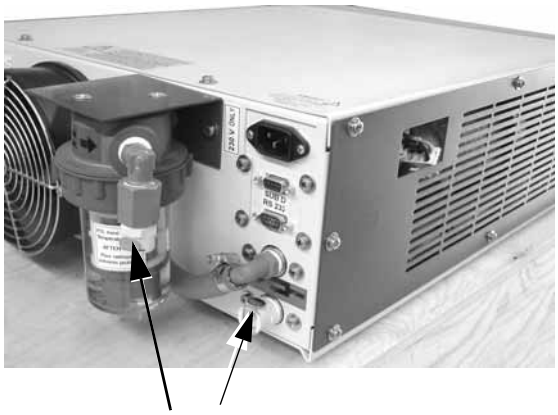


Figure 3-6. Chiller Voltage Selection

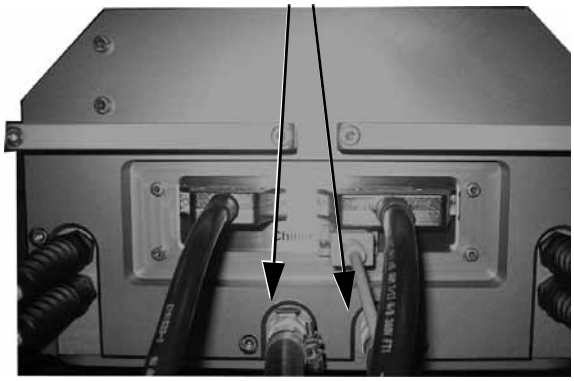
Cooling System

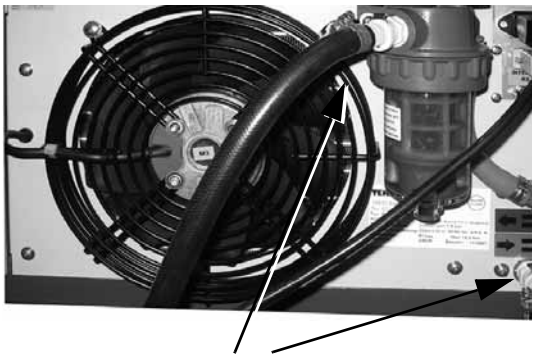
1. Connect the two black hoses to the chiller.
2. Connect the open ends of the two black hoses to the laser head. Flow direction is not important. See Figure 3-7.



Chiller Water Connections for Paladin™ 8W/10W

Laser Head Water Connections





Chiller Water Connections for Paladin™ 16/24/35 W

Figure 3-7. Chiller Water Connections

3. Flush system with distilled water, then fill with NALCO™ (see "Appendix A: MSDS and Directions for NALCO™ 460-CCL105" on page A-1). The system needs approximately 3 liters (1 gallon).
4. To fill the chiller (all laser types) remove the fill cap found on the front of the unit. Slowly pour in NALCO ™ until the coolant level reaches the "Max." on the fill indicator.

Figure 3-8. Chiller Setup and Control

Figure 3-9. P307-16273 Chiller

5. When the coolant level has reached the “Max.” line, connect the chiller to a power source. The chiller moves the coolant through the laser head and the coolant level will fall. Add more coolant to reach the “Max.” line.

   - Paladin 8W/10W: if the amount of coolant is not sufficient, one of two alarm LED's on the front panel will turn on.

- Water level low (yellow)
- Water level critical (red)

At initial installation, the yellow, red and the “Flow 1 LED” LEDs can turn on. If the LEDs turn on, continue to carefully add coolant to the system. When the yellow LED turns off, and remains turned off, disconnect the chiller from the facility power, then connect again. Press the STANDBY button to reset the alarm. The chiller will start normal operation.

- Paladin 16/24/35 W: If the amount of coolant is not sufficient, the red alarm LED will turn on. An error message “water level warning” also appears on the front panel display. Continue to add coolant to the chiller until the water level error message is gone. Press the QUIT button (arrow down) to confirm the error message and to turn off the red LED. After sufficient coolant has been added, press the ON/OFF button (arrow up) to start the chiller.

6. Confirm that there are no leaks at the water connection sites on the laser head and the chiller. Correct any leaks.

7. When the chiller is full, replace the fill cap.

The chiller keeps the laser head baseplate at the set temperature of 28°C/82°F (Paladin 8W/10 W) or 18°C/64°F (Paladin 16/24/35 W). The temperature is factory set during the production. Do not change the set temperature unless instructed by a Coherent service representative.

The chillers feature a signal connector for the temperature control feedback. An RS232 cable must be connected between the laser head-chiller interface and the female chiller port.

NOTICE!
Do not bend the optical fiber to a bend radius less than 15 cm. Optical fibers will be damaged.

Fiber Optic Connections

1. Loosen the screws on the front panel of the power supply to access the pump module assembly. Lift the front panel until it locks in open position.

   Pull the handle on the pump module assembly toward the top of the power supply to unlock, then rotate to lower the handle. Pull on the handle until the FAP module hits the “safety block” (see Figure 3-10).

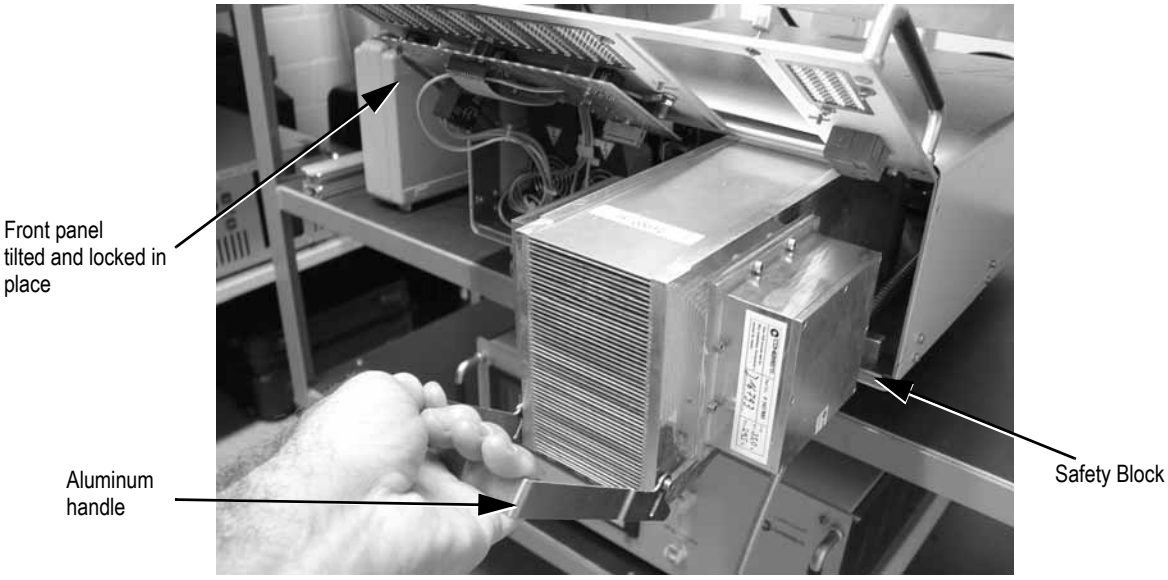
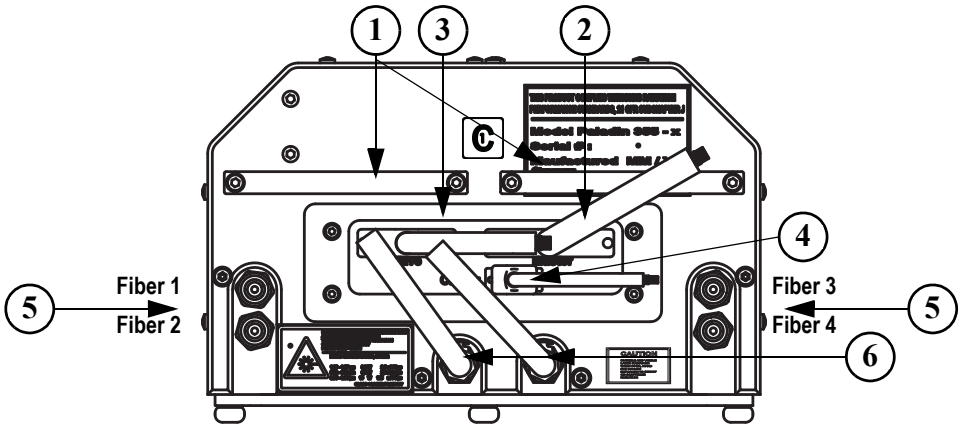


Figure 3-10. Access to the Pump Module Assembly

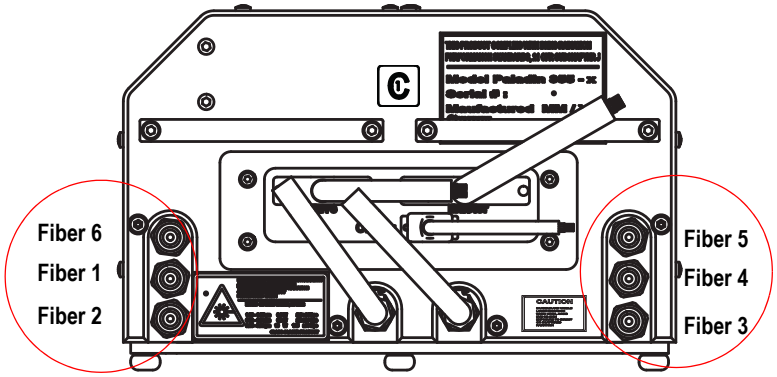
NOTICE!
Care must be taken in the next steps to attach the correct optical fiber to the pump module package. Keep the minimum 15_cm bend radius as the fibers are pushed through the power supply.

NOTICE!
If the laser is an internal part of a tool, secure fiber inside the tool (for example with cable-ties) to prevent damage. The OEM is also responsible to make sure that laser radiation emission is not possible if failure occurs.

2. Put Optical Fiber 1 through the “Fiber 1” feed-through hole of the master power supply (Figure 3-12). See fiber orientation on Figure 3-11 and Figure 3-12.



Paladin Advanced 8,16, 24 W

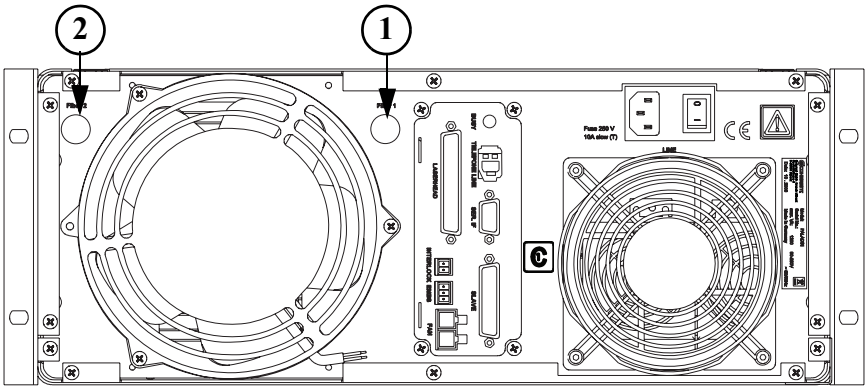


Paladin Advanced 35 W

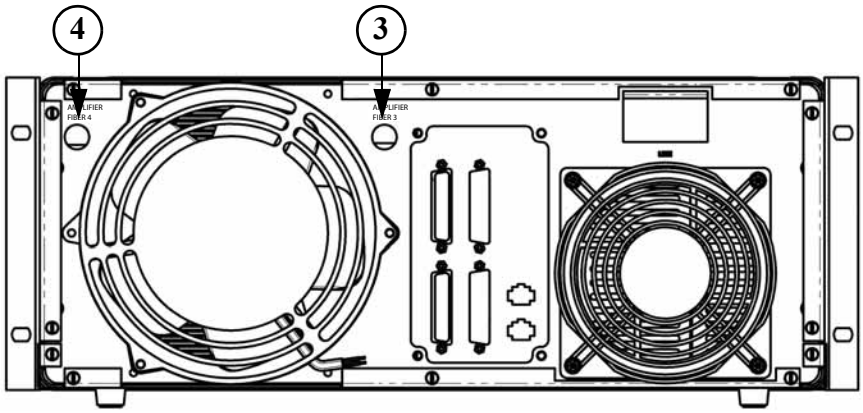
1. Shipping Handles
2. Head Cable 37-pin D-connector
3. Head Cable 25-pin D-connector (16/24/35 W only)
4. RS-232 Chiller Connector (option)
5. Fiber Optic Cables[a]
6. Cooling Water Connectors

Figure 3-11. Paladin Advanced Laser Head Connections

a. Fiber 3 and Fiber 4 are for 8, 16 and 24 W.



Master



Slave(s)

1. Fiber 1 feed-through
2. Fiber 2 feed-through
3. Amplifier Fiber 3 feed-through, Amplifier Fiber 5 feed-through for Slave 2 P/S on 35 W
4. Amplifier Fiber 4 feed-through, Amplifier Fiber 6 feed-through for Slave 2 P/S on 35 W

Figure 3-12. Fiber Feed-Through Holes

3. Remove and discard the FAP pump module protection cap.

NOTICE!

The following instructions are the most important part of the installation procedure. Tighten the SMA connector with the torque wrench in the accessory kit only. Use of another method to tighten the connector will cause damage to the coating of the fiber and the FAP.

A scratch on the surface of the fiber optic or contamination (caused by unsatisfactory cleaning) will cause damage to the coating. A major repair to the laser head will be required to repair this damage, including the possible exchange of the laser diode assemblies.

If there are questions or the fiber is damaged, contact your local Coherent customer support person.

4. Remove the protective cap on the fiber and inspect the fiber surface with an inspection tool for any dust particles or damage. Most fiber tips will require cleaning. If fiber tip must be cleaned, follow the directions shown in "Fiber Cleaning" on page 7-32.

5. Attach the first fiber to the pump module as shown in Figure 3-13. Use the 8 mm torque wrench from the Paladin Advanced Maintenance Kit. Align the black line on the fiber so it points 180° away from the middle of the pump module. Discard protective cap

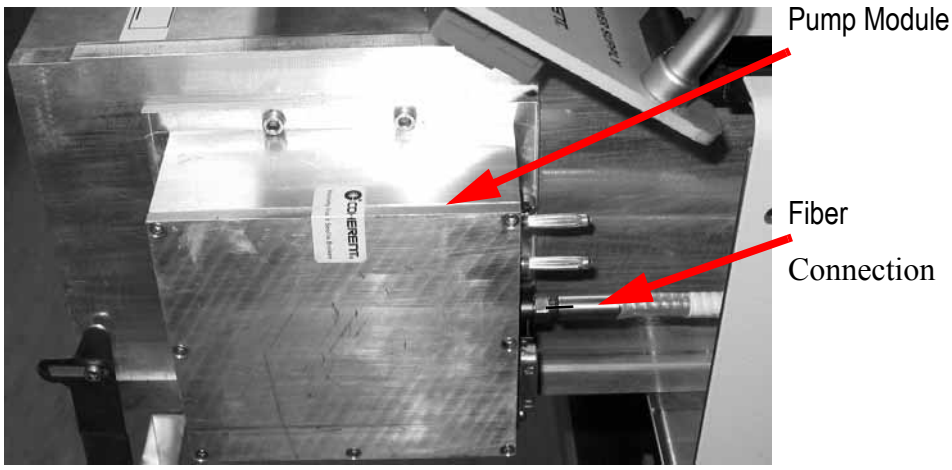


Figure 3-13. Attach the Fiber to the Pump Module

6. Repeat Step 2 through Step 5 for fibers 2-4 (**8, 10, 16, 24 W systems**) and for fibers 5-6 on the **35 W system**.
7. For **8/10 W**, after the fibers are connected, push the pump module into the power supply.
8. For **8/10 W**, close the front panel and tighten the screws to secure the front panel in position.
9. If the laser is installed in a tool, secure fiber cable inside the tool to prevent damage.
10. Fiber installation for the **8/10 W system** is complete. Continue on to "Electrical Connections" on page 3-19.
11. For the **16,24 and 35 W system**, confirm the voltage cables are not bent for LD2 (Master), LD4 and LD6 (Slaves) when the pump module is put into the power supply).

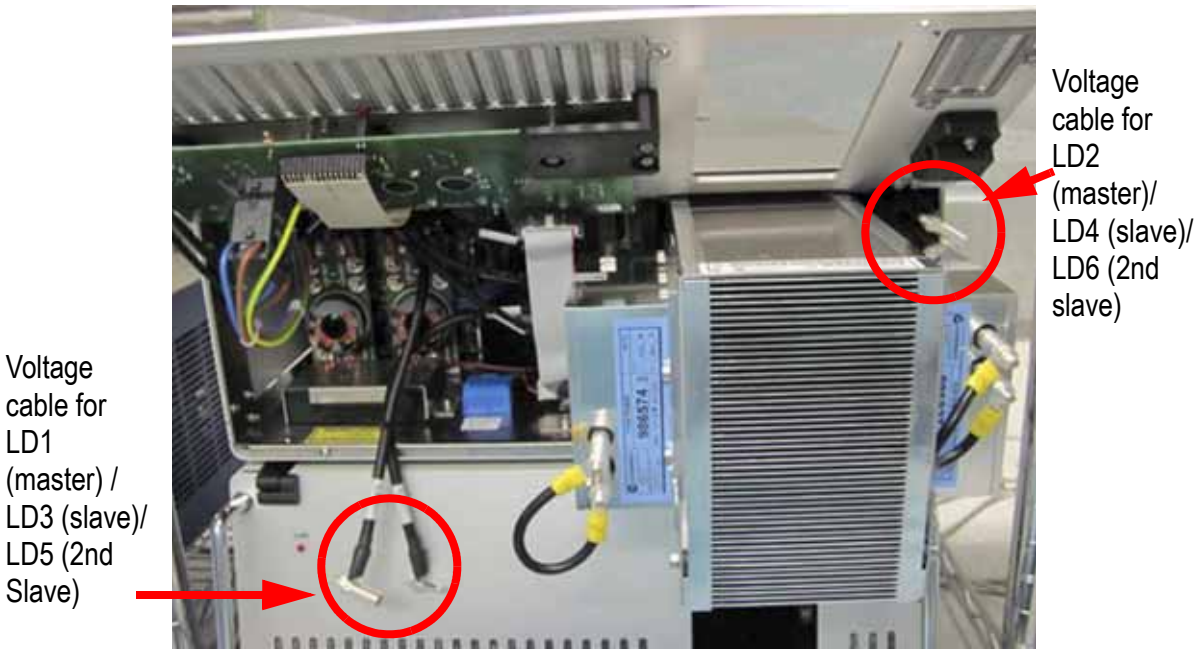


Figure 3-14. Voltage Cables for Diodes

12. Remove the jumper cable (or shorting clip) from LD2

Figure 3-15. Remove Jumper Cable (or shorting clip) from LD2

13. Connect the LD2+ cable to the bottom female connector of the pump module 2. Connect the LD2- cable to the top male connector of pump module 2.

Figure 3-16. Connect LD2 Voltage Cables

14. Remove the jumper cable (or shorting clip) from LD1. Then connect the LD1- cable to the bottom male connector of pump module 1. Connect the LD1+ cable to the top female connector of pump module 1.

Figure 3-17. Shorting Clip

15. Close the front cover of the master power supply. Then, for **16, 24 and 35 W systems**, continue with the connection of the voltage cables LD 3, LD 4 of the slave power supply.
16. For **16,24 and 35 W systems**, close the front panel of the slave power supply and tighten the screws to secure the front panel in position.
17. If the laser is installed in a tool, secure fiber cable inside the tool to prevent damage. Fiber installation for the **16 and 24 W systems** is complete. Continue on to "Electrical Connections" on page 3-19.
18. For the **35 W system**, continue with the connection of the voltage cables LD5 and LD6 of the second slave power supply.

Electrical Connections

Table 3-1 shows the cables supplied with the system to make the electrical connections. Follow steps given below to connect the laser head to the power supply (s) and chiller. Figure 3-11 is a graphical representation of the connections..

Table 3-1. Electrical Connection Cables

CABLE P/N	DESCRIPTION	IMAGE	SUPPLIED WITH
1096807	37-Pin, 5m, black		8,10,16,24,35 W
1116919	RS-232, Gray		8,10,16,24,35 W (Optional)
1104716	25-Pin, 5m, Black		16,24,35 W

Table 3-1. Electrical Connection Cables

CABLE P/N	DESCRIPTION	IMAGE	SUPPLIED WITH
1099242	2m, Gray		16,24,35 W (35 W requires 2.)
1216505	2m, Black		35 W

1. Connect the head with master power supply with cable 1096807.
2. For all power systems, as an option, connect the head to the chiller with cable 1116919. Electrical connections for the 8/10 W is complete.
3. For 16/24/35 W systems, connect the head with the Slave 1 power supply with cable 1104716.
4. For 16/24 W systems, connect Master power supply to Slave 1 power supply with cable 1099242.
5. For 35 W system, connect the Slave 1 to Slave 2 Power supply with cable 1099242.
6. Tighten the screws on the sides of all the connector cables to secure connections.

NOTICE!
Accidental disconnection of cables at laser head or power supply during operation, or cool-down period can cause damage to the system.

7. Connect the Master power supply to an external interlock circuit or install a jumpered interlock connector.
8. Confirm electrical, optical and water connections are complete, then connect the power supply to a line voltage.

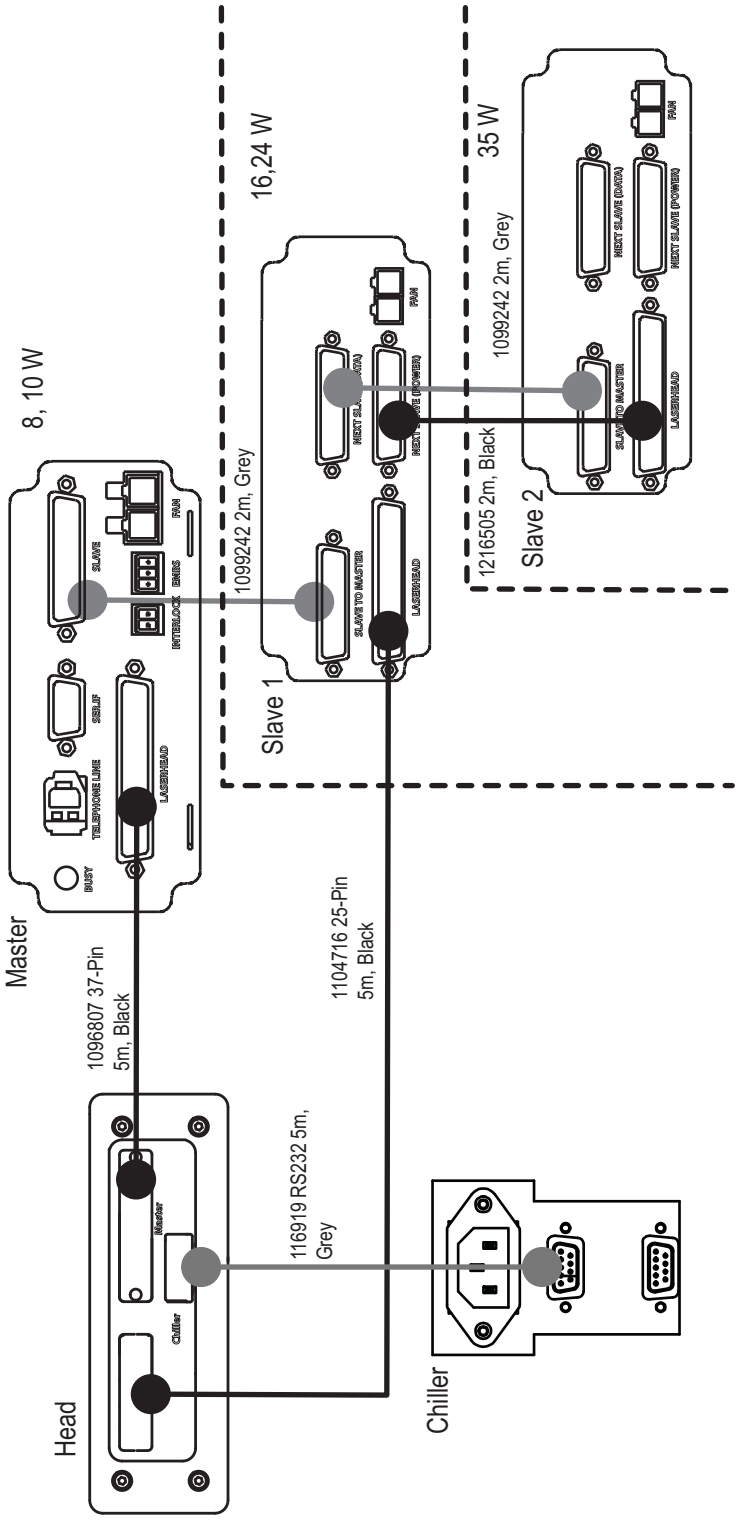


Figure 3-18. Electrical Connections

NOTICE!
The head cable must remain connected between the laser head and power supply during operation, and during the cool-down period. Confirm that the BUSY LED on the rear panel of the power supply is off before you disconnect the head cable.

WARNING!
Wear laser safety eyewear to protect against the radiation generated from the laser. It is the responsibility of the operator to have read and understood "Section One: Safety", and recognize laser safety practices and the possible danger. Make sure all personnel in the area wear laser safety eyewear.

Chiller to Laser Head Connection (option)

Use a standard RS-232 cable to receive chiller fault alarm messages from the chiller. See Figure 3-11 for connection diagram. Activate the chiller query with the service command "CH=1" (see Table 6-3 on page 6-5)

Active Chiller Control

The Paladin chiller is preset for "active chiller". "Active chiller" enables the chiller to get temperature feedback from the laser head for a more precise control function. To manually set the active chiller control, see below:

NOTICE!
A standard RS232 cable is required for the power supply to chiller connection. A standard RS232 is a 9 pin male to female connector. The pins are set as 1 to 1, 2 to 2, etc. If a cable different from a standard RS232 is used, the error message "F1" appears as the chiller will not receive a temperature signal.

1. Connect the laser head and the chiller with the RS232 cable (see Figure 3-11).

Program the chiller for active control 8W/10W System:

2. Set the chiller temperature to 28.0°C
   - Press SET and ▲ until 28.0°C appears on the display.

3. Check the real-time temperature of the heat sink of the laser (command ?HT0) with the HyperTerminal program. Compare this with the real-time temperature that the chiller has in its display. This temperature will not necessarily be 28.0°C. The length of the cable can create a difference in the two values. The value seen in the display can be corrected in the program level of the chiller.

4. Access the program level of the chiller with following steps:

   a.) Press ▲ and ▼ and wait for **"cod"** to appear in the display.

   b.) Press SET and ▲ until **"21"** appears in the display.

   c.) Release SET and **"cod"** appears again.

   d.) Press ▲ and ▼ until the first parameter **"P1"** appears. You have now have access to the program level.

5. Correct the set value offset:

   - Press Menu (Enter) until "Anwender Passwort" appears on the display.
   - Enter the pass code "2021". Use ▲ to change value. Use ▶ to move between digits. Press Menu (Enter).
   - Press ▼ until "Fühler FK" is selected. Press Menu (Enter).
   - Select F1 Sensor (Korrektur F1). Press Menu (Enter).
   - Calculate the correction value.
     correction value $=T_{HSH}-T_{Chiller}$
     Example: HSH temperature queried on the hyperterminal is 20°C. The temperature shown in display is 20.8°C. Correction value is -0.8°C.
   - Press ▲ or ▼ to change the correction value. Press ▶ to move between digits. Press Menu (Enter).
   - Press Esc.
   - "Wirklich speichern? Do you really want to save?" appears on the screen. Press Menu (Enter).
   - Press Esc to get out of the menu.

6. Adjust the proportional gain

   - Press ▲ until reaching menu P7
   - Press SET and ▲ or ▼ to adjust from 2.5 (factory setting) to **5.0**

7. Adjust the integral gain

- Press ▲ until reaching menu P8
- Press SET and ▲ or ▼ to adjust from 150 (factory setting) to **0**

8. Adjust the differential gain
   - Press ▲ until reaching menu P9
   - Press SET and ▲ or ▼ to adjust from 4 (factory setting) to **0**
9. Adjust the cycle time
   - Press ▲ until reaching menu P10
   - Press SET and ▲ or ▼ to adjust from 10 (factory setting) to **10**
10. Deactivate automatic PID optimization:
    - Press ▲ until reaching menu A30
    - Press SET and ▲ or ▼ to adjust from 1 (factory setting) to **0**
11. Close the program level to save settings:
    - Press ▲ and ▼ together. If none of the keys are pressed for 30 seconds while in the program level, the chiller control returns to the standard operation.

Active Chiller control 16/24/35 W System:

- The chiller for 16/24/35 W systems must not be programmed. All control parameters are pre-set by the chiller vendor.
- The chiller is set to 29°C. This is the STANDBY temperature used for heating the base plate of the laser. The display will show an actual temperature of 26°C. The temperature delta is due to a pre-set chiller offset for control purposes.
- When the laser is running, the chiller control will auto-select the control temperature to 18°C. This is done automatically.
- When the RS232 cable is not connected, the chiller will go back to 29°C (26°C in the display).

Initial Power-up

Turn the key to start the power supply. 11 steps of the turn-on process appears in sequence on the display. The 11 steps are described in Figure 3-19.

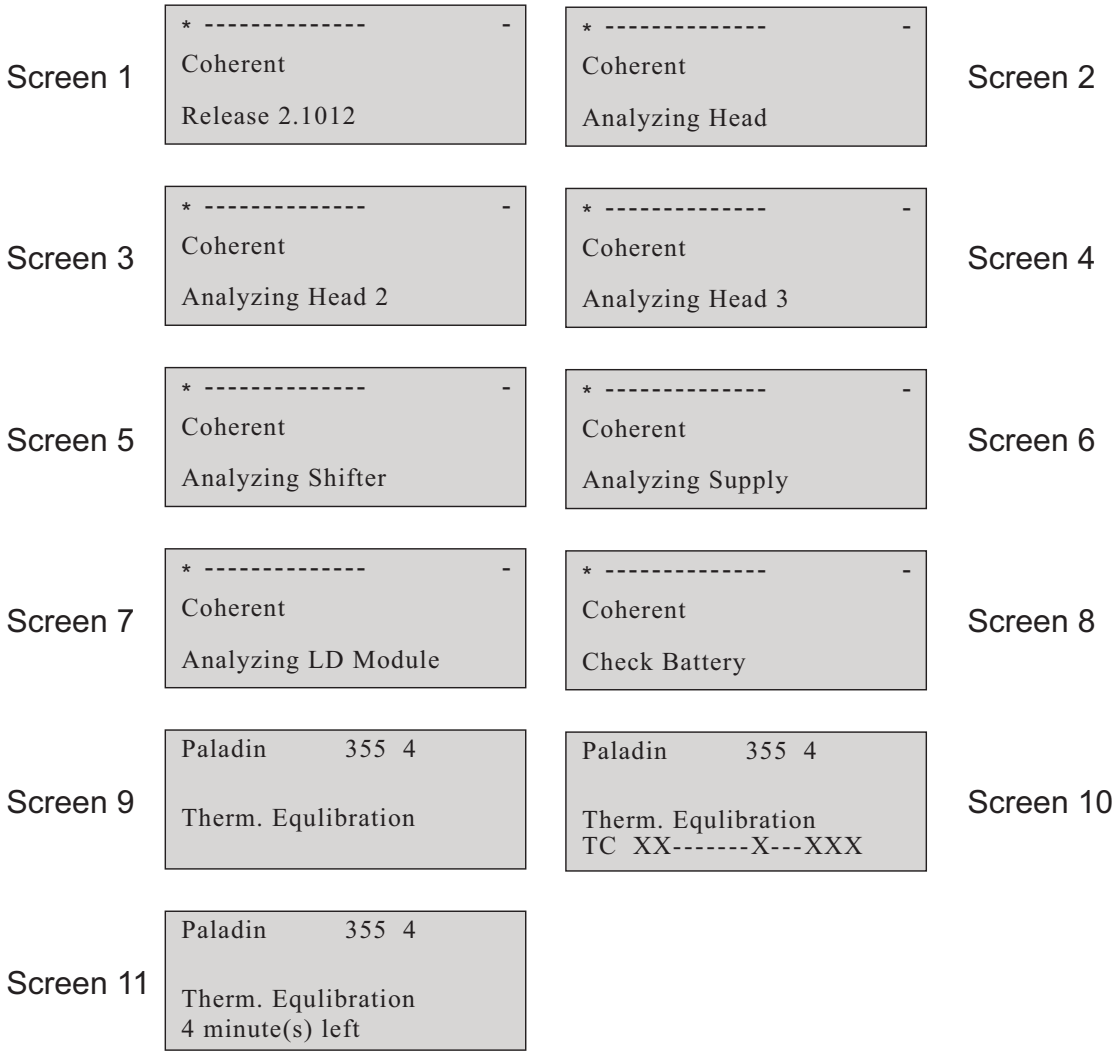


Figure 3-19. Power Up Sequence

Starting with Screen 1, a 10 second countdown starts. Screen 11 shows the minutes left until thermal equilibration is reached.

After the countdown is completed, press the LASER ON button to start the laser. Open the shutter to let laser emission through. See “Section Five: Operation”, for a complete description on the operation of the Paladin Advanced laser system.

Installation of Rack-Mount Options

The following outlines the installation procedure for the power supply and chiller rack-mount options.

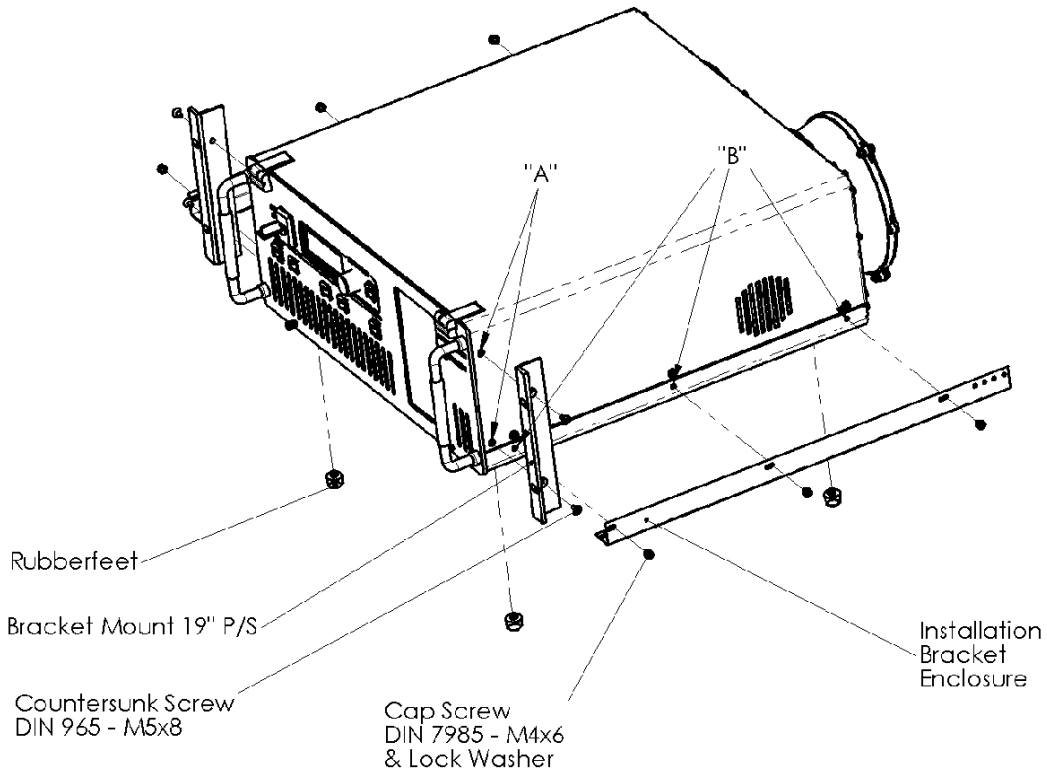


Figure 3-20. Power Supply Rack Mount Option

Power Supply Option

1. Remove the 4-cap screws and remove the lock washers from position A on both sides of the power supply (see Figure 3-20).
2. Set the 2 Bracket Mount 19 P/S into position A, on both sides of the power supply. Secure the Bracket Mount 19 P/S to the power supply with the 4-countersunk screws DIN 965 - M5x8.
3. Remove the four rubber-feet from the bottom of the power supply.
4. Unscrew the 6-cap screws and remove the lock washers from position B.
5. Set the two Installation Bracket Enclosures into position B and secure with the screws from step 3.

Chiller Option

1. Remove the 4-cap screws and remove the lock washers from position C on both sides of the chiller (see Figure 3-21).
2. Set the two Bracket Mount 19 Chillers into position C. Secure Bracket Mount 19 Chiller with the 4-countersunk screws, DIN 965 - M4x12.

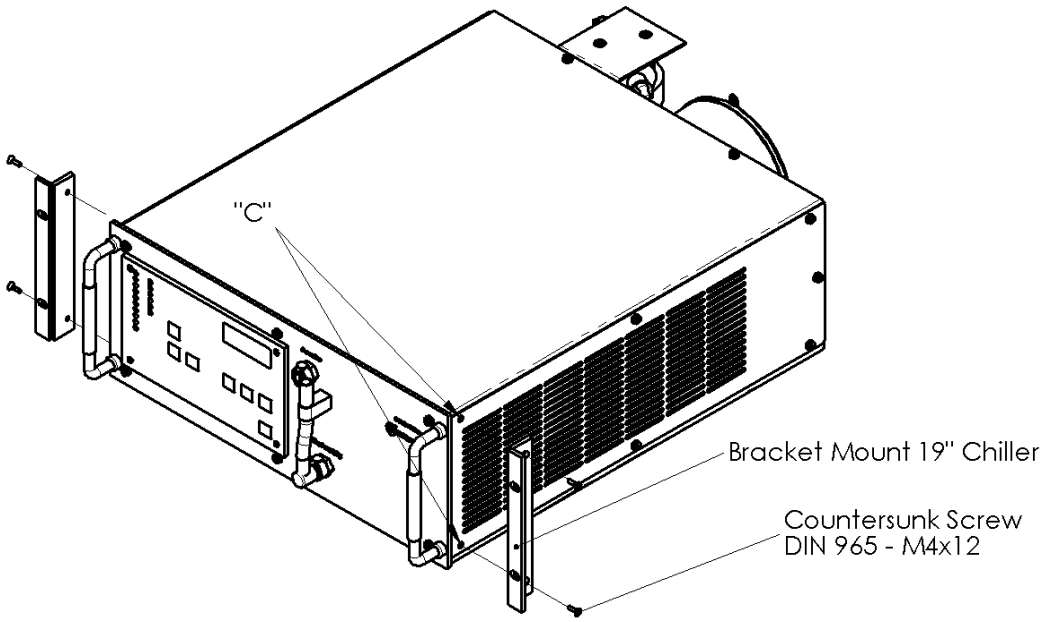


Figure 3-21. Chiller Rack Mount Option

NOTICE!
The front rail of the rack must hold 38 kg (> 84 lb). Confirm the rack rail can support the weight before the chiller is installed.

PARTS LIST

To order the parts , contact the Coherent Technical Support Hotline at 1-800-367-7890 (1-408-764-4557 outside the U.S.); through E-mail (clg.tech.services@Coherent.com); or your local Coherent service representative. Have the model and laser head serial number of your laser system available for the Product Support Engineer responding to your call.

Effective 1/2007, this Coherent laser system was released as RoHS-compliant. If your laser system was purchased prior to 1/2007, contact Coherent Technical Support to determine if the items shown below are the appropriate for your laser system. The manufacture date of your laser system is printed on the serial number label.

Table 4-1. Paladin Part and Option List (Sheet 1 of 3)

DESCRIPTION	PART NUMBER
PALADIN ADVANCED 355-8000 LASER SYSTEM W/O CHILLER	**1139280**
Paladin Advanced 355-8000 Laser Head	1127138
Paladin Advanced 355 P/S MASTER	1151419
Paladin Advanced Pump Module Assembly	1126941
Laser Head Cable	1096807
Chiller Tubes	1096057
Serial Cable for chiller remote temperature sensor	1116919
Shipping Crate for Laser Head	1037669
Shipping Crate for Power Supply	1037670
Paladin Advanced Operator's Manual	1147134
Accessory Kit	1052676
PALADIN 355 PALADIN ADVANCED 355-10000 LASER SYSTEM W/O CHILLER	**1155784**
Paladin Advanced 355-10000 Laser Head RoHS Compliant	1155778
Paladin 355 P/S Advanced 10W	1161868
Paladin Advanced Pump Module Assembly	1126941
Laser Head Cable	1096807

Table 4-1. Paladin Part and Option List (Sheet 2 of 3)

DESCRIPTION	PART NUMBER
Chiller Tubes	1096057
Serial Cable for chiller remote temperature sensor	1116919
Shipping Crate for Laser Head	1037669
Shipping Crate for Power Supply	1037670
Paladin Advanced Operator's Manual	1147134
Paladin 355 ACCESSORY KIT w/o Ethanol	1154809
PALADIN ADVANCED 355-16000 LASER SYSTEM W/O CHILLER	**1157642**
Paladin Advanced 355-16000 HEAD	1144430
Paladin MASTER High Power VEGA P/S W/O FAPs, RoHS	1150279
Paladin SLAVE High Power VEGA P/S W/O FAPs, RoHS	1150281
Paladin Slave PS Head Cable	1104716
Paladin Master to Slave head cable	1099242
Laser Head Cable	1096807
Chiller Tubes	1096057
Serial Cable for chiller remote temperature sensor	1116919
Shipping Crate for Laser Head	1037669
Shipping Crate for Power Supply	1037670
Paladin Advanced Operator's Manual	1147134
Paladin 355 ACCESSORY KIT w/o Ethanol	1154809
Paladin Advanced 16W Master Pump Module Assembly	1153864
Paladin Advanced 16W Amplifier Pump Module Assembly	1153866
Paladin Laser Chiller for Remote Temperature Sensor for Paladin 8W/10W	1114080
Laser Chiller for Remote Temperature Sensor and Remote Set Temperature P307	1151418
Shipping Crate for Chiller Paladin 355	1048245
Replacement Filter for Chiller	1037668
Corrosion Inhibitor Optshield (1 Pint)	1050571
PALADIN ADVANCED 355-24000 LASER SYSTEM W/O CHILLER	1192702

Table 4-1. Paladin Part and Option List (Sheet 3 of 3)

DESCRIPTION	PART NUMBER
Paladin Advanced 355-24000 Laser Head	1192703
Paladin Advanced 355 24W Master Power Supply	1195223
Paladin Advanced 355 24W Slave Power Supply w/o FAPS	1195224
Paladin 355 Tube Set	1096057
Paladin Advanced 24W Oscillator Pump Module Assembly	1192756
Paladin Advanced 24W Amplifier Pump Module	1192757
Paladin 355 Accessory Kit	1052676
Paladin 16W Laser Chiller for Remote Temperature Sensor P307, RoHS compl.	1151418
PALADIN ADVANCED 355-35000 LASER SYSTEM W/O CHILLER	1219423
Paladin Advanced 355-35000 Laser Head	1219425
Paladin Advanced 24/35W Master Power Supply w/o FAPs	1195223
Paladin Advanced 24/35W Slave Power Supply w/o FAPs	1195224
Paladin 355 Tube set	1096057
Paladin Advanced 35W Oscillator Pump Module Assembly	1207494
Paladin Advanced 35W Amplifier Pump Module Assembly	1207495
Paladin Laser Chiller for 16/24/35W	1151418
OPTIONS	
Paladin 355-8000 19” Adaptation Kit	1060686
Desiccant Replacement Set (set of two)	1052678
Pump Module (FAB-B) Shorting Clip	0171-199-00
Dust Cap FSMA Connector, set of 15	1069986
Dust Cap Fiber, set of 15	1069987
Shutter	1271234

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